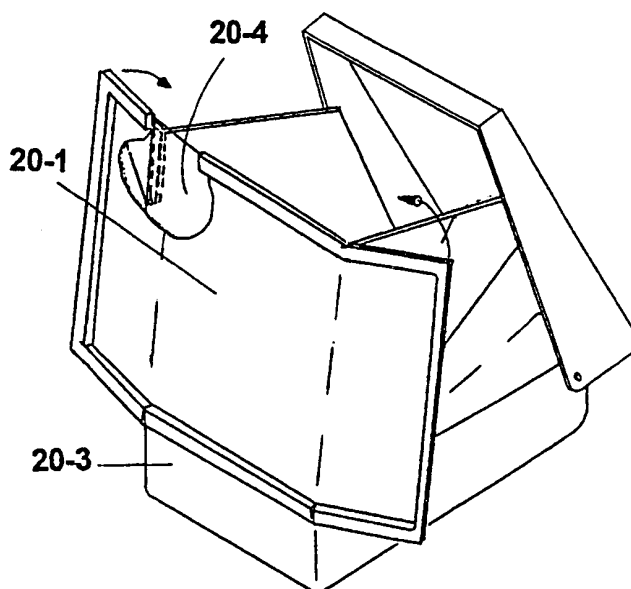




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(54) Title: PORTABLE VISUAL DISPLAY DEVICE WITH A COLLAPSIBLE PRESENTATION SCREEN

**(57) Abstract**

A collapsible presentation screen suitable for the presentation of still or moving images that are visible to a viewer situated in front of the front viewing surface by the diffusion of light images created within, or to the rear of the screen member. Embodiments are presented comprising a rigid or semi-rigid screen or alternatively a flexible and seamless screen and whereby the screen assembly when collapsed represents a much smaller size than its size when in the open condition thus rendering the screen readily portable and suitable as, or as part of a portable visual display device.

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PORTABLE VISUAL DISPLAY DEVICE WITH A COLLAPSIBLE PRESENTATION SCREEN

BACKGROUND OF THE INVENTION

5 Field of the Invention

The invention relates to a presentation screen for the presentation of still or moving visual images such as pictures, text or data to a group or a number of people in typical and everyday business, training, education, promotional or exhibition environments. The screen is of the diffusion type, using diffusion means for displaying the images on the front viewing surface. The screen may collapse into a smaller configuration such as to significantly increase its portability as required for being readily moved from room to room or travelling from place to place. The field of the invention also relates to the various forms of art that may be employed in its various embodiments as, or as part of, a visual display device.

20 The field of this invention does not include front (i.e. reflective) display screen devices or applications.

Description of Prior Art

25 Visual Display by means of cathode ray tube (CRT) devices is commonly used for computer monitors and televisions and can have relatively large screens (up to 40 inch (100 cm)) but these are bulky and very heavy and thus not truly portable.

30 Visual display by rear projection such as in TV units can provide a large screen area but such devices are not yet common and again the devices are large and bulky and thus not truly portable.

35

Visual display devices using a Liquid Crystal Display (LCD) are common particularly in laptop computers and are highly portable but their limited screen size (14 inch (35 cm)) makes them unsuitable for presentational use involving several persons viewing the screen simultaneously in comfort.

Various other displays are appearing such as plasma screens that are large screen (up to 42 inch (105 cm) currently) and that are almost flat for hanging on a wall, but again are relatively heavy and bulky so not truly portable.

Visual display by large screen front projection means is popular in business and at home. Use may be in circumstances of a fixed set-up in a special room or in a portable or travelling manner. However the latter requires some preparation -possibly in front of a waiting client or audience. Depending on circumstances it may require suitable lighting conditions, a screen and the physical space to the projector to be available. This can be a particular disadvantage when associated with use where visiting in a business environment since it may be considered professionally "intrusive" to impose these requirements on a client even for informal presentations.

Many visual display devices have tried to employ the systems above within a more or less portable package. In general these are subject to the limitations either that the viewable screen is smaller than the case within which it is carried or, where the display screen is larger than the case and is in some way disassembled for storage and carriage, use of the screen requires user intervention to then assemble the screen and other required elements which is again an inconvenience and takes time.

There are known methods for the collapsing of seamless front projection screens that employ flexible screens which fold away for storage. However these collapsing methods have not generally proved applicable in translucent diffusion screen applications for the reasons set out below.

Front Projection screens are not translucent and therefore typically consist of a reflective front surface with a reinforced backing that provides considerable physical "body" to the material such that it does not require to be stretched to operate or reflect light uniformly - although it may be hung or stretched to stay in an approximate planar condition. Further, physical damage such as creases or folds in the screen surface are not highly critical to the optical performance as no light passes through the material.

Flexible screens suitable for use in say a portable rear projection application, are by necessity of their unique optical transmissive and controlled diffusive requirements, very thin, of a totally different translucent and very homogeneous material without any reinforcing layer, must be under at least minimal tension and physical distortion and non-planarity must be avoided. Further, any crease or fold of the material (even whether still physically present or not) may cause optical distortion to the passing light and images or cause "rainbow effect" or "white-spots" and result in very irritating screen flaws to a viewer.

As a result, the technology of the screen, its material and also the optical and physical requirements in use are very different from those applicable to reflection screens. Further, the demands of preserving the screen optical qualities and screen longevity (especially in required highly repeated or rapid opening and closing

actions) are of a much higher critically in "fit for purpose" concerns. In consequence, particular difficulties are encountered in developing collapsible screens of this type, and it has not been generally possible to apply collapsible concepts from the reflection screen art to screens designed for the application of the present invention.

OBJECTS OF THE INVENTION

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Accordingly:

It is an object of the present invention that it generates the viewable optical images on the front viewing surface by the diffusion of light comprising of images that may originate from a light source within, immediately adjacent or at a distance to the rear the front viewing surface.

It is an object of the present invention that it provides a visual display screen with a viewable surface area that is sufficiently large such that it may be readily and comfortably viewed by several people.

It is an object of the present invention that it may be viewed in typical in-door environments without need for further space or apparatus (other than if an external media source is required).

It is an object of the present invention that the screen assembly is collapsible such that the viewable screen area is considerably larger when in an open condition than its largest area of encumbrance when in a closed condition thus providing a portable nature suitable for carrying from room to room or for travelling from place to place.

It is an alternative object of the present invention that it provides a visual display screen that presents a joint-less and essentially planar screen to a viewer situated in front of the viewing surface.

5

It is a desirable object of the present invention that it may be considered as "self-collapsing" that is to say that it can be deployed or collapsed as an integral assembly whereby the screen assembly does not require user intervention such that any parts be removed, added, attached, detached, re-located, tightened or loosened and requiring only direct opening or closing actions.

10

It is a desirable object of the present invention that it employs specific means or methods such as jointing means, mechanisms, elements, materials, shapes or geometrical configurations that are intended by their presence or operation or action to prevent or reduce any damage or deterioration of a physical or optical nature that may occur to the viewable screen area due to any single or occasional or often repeated actions or movements or sustained positions of the collapsible screen assembly.

15

20

It is a desirable object of the present invention as, or as part of, a portable visual display device, to be readily and rapidly deployable to a useable state with a set-up time of several seconds.

25

It is a desirable object of the present invention as, or as part of, a portable visual display device, that it comprises true portability in a hand portable case.

30

Briefly stated, the present invention relates to a portable screen for presentation purposes that can be used as, or as part of, a visual display device that is suitable in its various embodiments for making presentations of a business, professional, promotional,

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marketing, advertising, communication, training or educational nature to many people situated in normally lit indoor environments such as in typical business environments, meeting rooms or offices, classrooms, 5 lecture-rooms, exhibition halls, point-of-sale areas, gymnasiums etc., A possible embodiment of the invention is as an optional accessory to conventional projectors.

Summary of the Invention

10

In accordance with the principles of the present invention, the foregoing and other objects are achieved by a screen assembly composed of a surrounding frame member to which is permanently attached a viewable screen 15 member composed of a material that is attached and supported within the said frame member. The screen member acts as a display screen by the diffusion of images on a front viewing surface the images being produced by light-imaging elements or devices located within or to the rear 20 of the forward facing viewing surface. The screen assembly includes jointing means permitting it to move as an assembly between two conditions such that it can be rapidly opened and used as a display device or rapidly collapsed into a closed condition that represents a much 25 smaller configuration suitable for ready transport or storage.

Accordingly, a screen assembly for a portable visual display device comprises a frame member to which is 30 permanently attached a screen member for the presentation of visual images on a front viewing surface to persons located on a viewing side by diffusion of optical images created to the rear of this front viewing surface (which is to say images that may originate from within, 35 immediately adjacent to or at a distance from the rear of the screen, but which excludes reflecting screen front

projection) wherein the screen assembly comprises at least two screen and frame sections connected by jointing means such that the screen assembly is deployable into an open condition for visual display and collapsible into a closed condition in such a manner as to significantly reduce the screen member area when in the closed condition.

Thus, the screen assembly is collapsible such that the viewable screen area is considerably larger when in an open condition than its largest area of encumbrance when in a closed condition. The resulting assembly is potentially provided with a portable nature suitable for applications involving carrying from room to room or travelling from place to place.

In one series of alternative embodiments it may be desirable for the screen to have a joint-less configuration on its viewable surface and to this end the assembly may use a screen member of a flexible nature, with the screen member comprising a flexible material. In the alternative, the assembly may use a screen member of a rigid or semi-rigid nature with the screen member comprising rigid or semi-rigid material, and individual screen section elements may be jointed on the viewable surface of the screen.

The material of the screen member may be active such that images are created and diffused from within the screen member, or a layer thereof, by an active imaging material or elements or by elements or materials that may modulate light.

In the alternative, the material of the screen member may be of a passive translucent nature suitable for the diffusion of optical images projected through the screen

member from a projection device located to the rear of the screen member.

It will be understood that the invention covers any combination of the above described active or passive
5 screen with flexible or non flexible screen.

In respect of all such combinations, the screen assembly may be composed of a screen member retained within a screen frame member having jointing means thereon (such
10 as hinges or the like) such that any section of the screen assembly may fold about one or more axes determined by the jointing means in such a manner as to significantly reduce the screen member area when in the closed position.

15

The screen assembly and jointing means are preferably so configured that a screen and frame section (as determined by the frame jointing means such as hinges) may rotate or fold about the jointing means through approximately 180
20 degrees into a flat position adjacent other screen and frame sections.

The screen assembly and jointing means are preferably so configured that the screen and frame sections may rotate
25 or fold about the jointing means such that a screen section lies substantially perpendicular to another or several other screen and frame sections.

-- For example, the screen and frame sections may rotate by
30 jointing means about the frame axis enabling outer screen sections to rotate so that the said outer sections are perpendicular to the remaining screen sections when in the closed condition.

35 The screen and frame sections of the screen assembly may be so arranged that sections of the screen assembly are enabled to rotate about at least two axes one of which is

not parallel to any other axis, or about at least two axes of which at least two are essentially parallel, or about two parallel axes and a third perpendicular axis.

- 5 The screen frame member may be provided with screen frame supporting panels or members that are attached by jointing means to the edges of the screen frame such as to provide mechanical support to the screen assembly when in the open condition and to lie flat with the screen
- 10 member or sections thereof when in the closed condition. A plurality of screen frame supporting panels or members may be provided connected by jointing or hinging means. Some or all of the axes of rotation of the jointing means
- 15 between frame supporting panels are preferably configured to fall essentially parallel and co-incident or adjacent to axes of the jointing means of the screen assembly when the frame support members are closed flat against the screen member.
- 20 The frame supporting member or panel or multiplicity thereof is or are attached by a jointing means to the frame member and which lies flat and adjacent with the screen member when the screen assembly is in the collapsed position and deploys in such a manner as to
- 25 provide substantial mechanical support to retain the screen assembly in the upstanding position and/or to retain the frame elements in the fully open condition for viewing of the screen images.
- 30 It is a preferable feature of the aforesaid screen assembly and jointing means that they are together configured to avoid or reduce any optical or physical damage or deterioration to the viewable surface of the material of the screen member that may be caused by any
- 35 position thereof or due to any repeated opening or closing actions.

The jointing means may be configured such that they provide axes of rotation that are virtual or pseudo-virtual or are axes that may move out of the physical
5 section of the frame elements or jointing means.

Another possible member is a base member that can be placed on a flat surface and to which the screen assembly and/or any present frame supporting member can be
10 attached such as to be supported in the upstanding position upon or by the base member. This base member may be configured as an enclosure preferably with a lid into which the said screen assembly can be stored and secured for transport. The base member if constructed as an
15 enclosure may also contain a media source to store the images.

Thus, the invention further comprises a portable visual display device comprising a screen assembly in accordance
20 with any preceding claim wherein the screen assembly is mounted to a base member suitable for seating on a flat surface such that the base member provides support to retain the screen assembly in an upstanding position when in the open condition.

25 Within the context of its use as, or as part of, a visual display device then another possible member is an light-imaging means or device capable of creating the display images so:

30 Another possible member is a projection device or projection means whereby the images on the front viewing surface of the screen are generated by rear projection of the images through a translucent screen material suitable
35 for such purposes. The projection device may be utilised as an integral, removable or attachable unit which may be integral, removable or attachable to the base member or

enclosure means, and the projection device, base member or enclosure means may have associated with it a mirror or mirrors such that the optical light path from the projector can be folded back to thus reduce the physical path distance from projector to screen member .

The apparatus may optionally be provided with a light-shield member that may be used with the aforesaid projection device to ensure that ambient light cannot impinge on the rear side of the screen member to the detriment of image quality while the screen assembly is operational. This light shield is preferably also collapsible into a much smaller closed condition either with or separately from the screen assembly.

In a preferred arrangement the light shield is deployable in the open condition so as to be adjacent or attached to the upper horizontal and side upstanding frame elements of the screen assembly and to extend downwards and rearwards towards the base member.

The base member may be configured as an enclosure with a lid such that the enclosure lid when open acts as a part of the light shield.

The light shielding member may be jointed to the screen assembly such that it is collapsible from the open and deployed condition to a collapsed condition adjacent to the screen assembly, and preferably the light shielding member or any part or element thereof is jointed to a screen frame edge and acts as a frame supporting panel such as to provide mechanical support to the screen assembly when in the open position. Also, the light shielding member or any part or element thereof may act as a screen material support member that can be brought into a position adjacent and parallel to the axis of rotation of the screen assembly sections such as to act

as a support or guide to the screen member material as it wraps around the screen material support member during the rotation of the screen assembly sections during the closing action and when in the closed condition.

5

A particular embodiment of the invention utilising a projection device can form a configuration that enables the screen and light shield member to be attached together by jointing means enabling them to open and close integrally as a single entity and to preferably collapse into the aforesaid enclosure. The light shielding member may be configured to collapse in a secondary collapsing movement in co-operation with the collapsing movement of the screen assembly such that the combined device collapses to a closed condition, and in such arrangement the axis of collapsing of the screen assembly and the secondary axis of collapsing of the light shielding member are preferably parallel and adjacent or co-incidental.

20

Alternatively, another image producing means may be whereby the screen member comprises an active image creating means within the material of the screen or any layers thereof or has the image creating means positioned behind and adjacent to the screen rear surface or the image creating device is behind and remote from the screen member (such as in rear projection).

25

It is desirable that each or all of the aforesaid members or elements may be considered as "self-collapsing", that is to say can be collapsed or deployed without need for user intervention to deploy or collapse the assembly or combined assemblies other than by a direct action only to open or close (or short series of simple actions in the case of combined assemblies) or by actuation of a mechanical or motorised drive to perform the same.

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Other alternative features of the invention will be apparent from the appended claims.

Brief Description of the drawings.

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Figure 1 is a perspective drawing that shows an example of a general visual display screen assembly.

10 Figure 2 is a perspective view of two embodiments including a single axis of rotation.

Figure 3 is a perspective view of two embodiments including two axis of rotation of which both are, in the examples shown, parallel to one another.

15

Figure 4 is a perspective view of two embodiments including two axis of rotation of which both are parallel to one another and whereby the outer sections of the screen assembly are not overlapping.

20

Figure 5 shows a perspective view of a screen assembly utilising a rigid screen frame member.

25 Figure 6 is a cross-sectional plan view of the assembly of figure 5.

Figure 7 is a cut-away perspective of a possible simple embodiment of a jointing means.

30 Figure 8 is a cross-sectional view of a preferable embodiment of a jointing means that has a combined linear and rotational action that provides an action similar to a virtual axis of rotation outside of the physical frame elements.

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Figure 9 is a cross-sectional drawing that shows another embodiment of a jointing means that achieves the same result as that shown in Figure 8.

- 5 Figure 10 is a cross-sectional drawing that illustrates the above embodiment of Figure 9 with screen frame element rotated through 180 degrees.

- 10 Figure 11 is an exploded and partially cut-away perspective drawing that illustrates an embodiment of the detail of the jointing means as illustrated in Figures 9 & 10.

- 15 Figure 12 is a detailed cut-away perspective view of the jointing means as described in Figures 9, 10 & 11.

- 20 Figure 13 is a perspective view similar to Figure 12 and showing only the screen element, its attachment members and an further optional screen material support member.

Figure 14 is a cut-away perspective view of another embodiment of a jointing means using only folding methods.

- 25 Figure 15 is a perspective view showing in more detail an embodiment similar to the embodiment of Fig 4A.

Figure 16 is a perspective view similar to figure 15 whereby frame support panel members are shown.

- 30 Figure 17 is a perspective view similar to figure 16 that shows the screen assembly retracted back to be adjacent to the front edge of the base member.

- 35 Figure 18 is a perspective view of an embodiment of a visual display device similar to figure 17 but using a screen assembly with two parallel axis of collapsing and

with a screen member of a material suitable for rear projection.

Figure 19 is a perspective view of the same device as in
5 Fig 18 whereby the screen assembly is shown folding
downwards towards the screen assembly.

Figure 20 is a perspective view of the same device as in
Fig 19 whereby the top light shield member has folded
10 downwards against the screen assembly.

Figure 21 is a perspective view of the same device as in
Fig 20 whereby the screen assembly sections and light
shield sections have rotated about the two parallel axis
15 to approximately 90 degrees.

Figure 22 is a perspective view of a collapsed screen
assembly similar to that presented in previous figures
and using two parallel axis of collapsing with a further
set of hinge elements that define a third axis
20 perpendicular to the two existing parallel axis.

Figure 23 is a perspective view similar to that of Figure
16 that illustrates a further embodiment of the invention
whereby the top section of the screen assembly can hinge
25 down as a secondary screen collapsing action.

Figure 24 is a perspective cut-away view similar to that
of Figure 13 that illustrates a further embodiment of the
proposed screen material support element.
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Figure 25 is a cut-away and exploded perspective view of
part of the screen member and the screen material support
element at the critical positions.

35 Figure 26 is a perspective view of the screen assembly
being attached by jointing means at its lower edge to a
base member

Figure 27 is a perspective view showing a frontal view of the screen member in the open condition. A light shield member is also shown.

5

Figure 28 is a view similar to that of Figure 27 but from a rear perspective.

10 Figure 29 is a view similar to Figure 28 but with the light shield member moving to the collapsed condition.

Figure 30 is a view similar to Figure 29 and with the light shield member fully folded against the rear face of the screen assembly.

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Figure 31 is a horizontal cross-sectional view through the lower frame member.

20 Figure 32 is cross-sectional view along a vertical plane passing longitudinally through the centre of a device similar to that as described in Figure 27 and exposing by way of example a suitable internal arrangement of the device.

25 Figure 33 is a possible embodiment showing the visual display device incorporating an audio system and "plug-in" modules to provide image media such as by a DVD player or Television tuner or PCM card similar media source and a removable projector unit.

DETAILED DESCRIPTION OF THE INVENTION & ILLUSTRATED EMBODIMENTS

Figure 1 is a perspective drawing that shows an example
5 of a general visual display screen assembly wherein a
rectangular supporting frame member (1-1) supports the
screen member (1-2) that is permanently attached (except
for replacement purposes) to the frame member. The screen
member is held to be flat within the frame member (1-1)
10 by its being attached to the four sides of the frame
member. The frame member can be considered to comprise
the two upstanding side elements and the upper and lower
horizontal elements. A magnified cross-section of the
frame and screen members is shown for clarity and
15 illustrates a simple example attachment method using a
push-in mounting of the screen member into a slot in the
frame member *a rigid or semi-rigid nature with the
screen member comprising rigid or semi-rigid material,
and individual screen section elements may be jointed on
20 the viewable surface of the screen.

The material of the screen member may be active such that
images are created and diffused from within the screen
member, or a layer thereof, by an active imaging material
25 or elements or by elements or materials that may modulate
light.

In the alternative, the material of the screen member may
be of a passive translucent nature suitable for the
30 diffusion of optical images projected through the screen
member from a projection device located to the rear of
the screen member.

In the case of a rigid screen where the screen and frame
35 members may exist as a single part or two integrally
bonded parts then the frame member can be considered to

be any non-viewable external structure or area of the screen member that acts to provide mechanical support to the viewable area or to any jointing means or other attachments.

5

Embodiments of a collapsing screen assembly based on the general assembly shown in Figure 1 can be configured to have many different closed configurations that may include single or multiple methods of movement such as
10 linear or rotational movement or any combination thereof and whereby rotational movement may include single or multiple axes of movement that may or may not be perpendicular or may or may not be parallel to each other. Further, in the case of rotational movement, an
15 axis of rotation may be a physical axis or a virtual axis of rotation and may permit rotation through a range of angles.

Possible embodiments of a collapsing screen assembly are demonstrated by way of example, but are not limited to,
20 the configurations as shown in the following Figures 2 through 4 wherein possible closed conditions are shown and the original open position of the screen assembly is indicated by a dashed line. Arrows indicating the
25 direction of movement are omitted as this is considered obvious. However the screen member surface is indicated by a light dashed "Z" shading to clearly identify its presence.

30 The following figures 2, 3 & 4 are by way of illustration of the possible open and closed configurations as may be applicable to screen material of a rigid, semi-rigid or flexible nature

35 Figure 2 is a perspective view of two similar embodiments with a collapsing action about a single axis of rotation. The upper shown embodiment (Fig 2A) has an upstanding

axis of rotation (A-A) and the lower shown embodiment (Fig 2B) a horizontal axis of rotation (B-B).

Figure 3 is a perspective view of two similar embodiments with a collapsing action about two parallel axes of rotation. The upper shown embodiment (Fig 3A) is an example with the outer sections of the screen assembly (3-1) & (3-3) rotated to 90 degrees to the central section (3-2) such a configuration may be used for example where the screen assembly sections are required to be closed to a position adjacent to the sides and top of an enclosure. The lower shown embodiment (Fig 3B) is similar to the upper shown embodiment except that the outer sections (3-1) & (3-2) rotate through approximately 180 degrees between open and closed conditions. As a result said sections (3-1) and (3-3) overlap such as to be partially super-imposed in the closed condition so as to lie relatively flat. Such a configuration may be preferable for wider screen formats.

Figure 4 is a perspective view of two similar embodiments with a collapsing action about two axes of rotation of which both axes are parallel to one another and whereby the outer sections of the screen assembly are not overlapping in the closed condition. The upper shown embodiment (Fig 4A) is an example wherein the outer sections of the screen assembly are rotated by 180 degrees. The lower shown embodiment (Fig 4B) is similar to the upper shown embodiment but with a further horizontal axis of rotation (C-C) traversing the upstanding frame side elements and thus permitting the upper section of the screen assembly to rotate to 90 degrees (as shown) relative to the lower section. This could be rotated further to an angle of 180 degrees (shown in a later example).

Referring to Figures 2 through 4, it will be understood that in all of the embodiments presented either side of the screen element could be considered as the front or the rear side from the point of view of viewing and that the operations of the embodiments are also valid with the axes located at a disposition at 90 degrees to those shown.

Referring further to Figures 2 through 4, it was noted that the screen member material could be of a rigid or semi-rigid or flexible nature. The embodiment of Figures 5 and 6 comprises a rigid or semi-rigid screen material. Subsequent figures comprise a screen of a flexible nature. However, it will be readily understood that the descriptions and methods of the embodiments shown therein also apply, although possibly in a simpler manner, to equivalent or similar embodiments comprising a rigid or semi-rigid screen.

Figure 5 shows a perspective view of a screen assembly with a rigid frame member composed of the upstanding frame elements (5-9) and (5-10), the lower frame elements (5-6), (5-7) and (5-8), and the upper frame elements (5-1), (5-2) and (5-3) and having inset a screen member (5-12). The outer screen assembly sections may rotate about the axis (A-A) and (B-B) as indicated by the arrows due to jointing means (5-5) between frame elements (5-1 to 5-2), (5-2 to 5-3), (5-6 to 5-7) and (5-7 to 5-8) and whereby there is a physical joint in the screen at the positions shown (5-4) & (5-11).

Figure 6 is a cross-sectional plan view of the assembly of figure 5 along the plane defined by axis (C-C) & (D-D) in figure 5. The two outer sections are shown to be rotated through approximately 180 degrees to be adjacent to the central section and / or themselves by superimposition (as also previously shown in figure 3B).

The superimposition is aided by use of tapered frame elements (6-1), (6-3), (6-6) and (6-8) and jointing means (6-5) of different offset at each side. This configuration is simple and is suitable for all screen
5 formats and particularly wider screens (such as 16/9 formats) but has the disadvantage of having joint lines on the viewable screen area. Although the upstanding frame elements (6-9) and (6-10) may comprise a pre-tension such as to keep the screen sections under tension
10 to assist in retaining their planarity and hence alignment between sections when in the deployed and open condition, this aforesaid disadvantage may not be acceptable.

15 The subsequent figures refer to embodiments that avoid such joints on the viewable screen face by the use of a seamless flexible screen. However the embodiments and their features therein are also applicable to such embodiments as may comprise a rigid or semi-rigid screen
20 with joints.

In reference to the collapsing actions shown in the basic embodiments represented in Figures 2 through 4, it will be evident, that further refinements are desirable to
25 assure longevity of a flexible screen member under repeated opening and closing actions. Such refinements are illustrated in the embodiments shown in Figures 7 through 13.

30 Figure 7 is a cut-away perspective that shows by way of example a possible simple embodiment of a jointing method wherein a section of the lower frame member comprises of frame elements (7-1) & (7-2) that are connected by a simple hinge mechanism element (7-3) along the axis (A-
35 A). A slot exists in the frame element and is situated above hinge (7-3) at the position indicated by arrow (B). The flexible screen member (7-5) is of a flexible

material that is attached to screen attachment members (7-6) and together can then be attached to the frame via the slot at (B) and locked in place by any appropriate means (not shown in the figure for clarity). The screen member (7-5) extends upwards towards the top of the screen member where the upper frame elements (not shown) contain the opposing hinge elements situated on the same axis (A-A). The upper elements are arranged in a similar but inverted manner. It can therefore be noted that the screen member in this case does not extend across the hinge elements.

In reference to Figure 7, there is a potential disadvantage to this configuration in terms of longevity and reliability as there is by necessity a break in the attachment members (7-6) and the screen member (7-5) at the position (D) to enable them to open with the frame elements (7-1) & (7-2). This creates a localised stress and possible fatigue point at position (D) of the screen member that may cause deterioration or tearing of the screen due to repeated opening or closing and / or by the additional stress caused by the increased tension of the screen member at position (D) as the two elements (7-1) & (7-2) initially separate longitudinally to commence their rotation to the closed position. This situation is shown in the lower encircled schematic that has been added for clarity and indicates this increasing gap as identified by the arrow (C). A desirable configuration is required whereby the stress at (D) is reduced to an acceptable level thus requiring that the gap at arrow (C) will not occur or will be considerably reduced and/or that any stress is distributed over a larger area and/or a durable support may be added to the screen member at (D) that will not be visible or deteriorate the screen image quality.

A solution to the aforesaid disadvantage can be that the frame member can be much thicker in the vertical plane of the example shown such that the hinge mechanism can be retained towards the outside of the said frame thus
5 permitting a larger area of screen located behind the frame and permitting that additional support can be added. However this thicker screen has other disadvantages due to the additional volume of frame to be collapsed and stored. A preferable embodiment is whereby
10 the screen member is extended past the hinge mechanisms to be attached towards the outside of the screen frame and thus distributing any screen member stresses or fatigue over the larger area now present and immediately adjacent to and behind the frame member and also enabling
15 that additional support can be attached to this same area where it will not be visible to a viewer. However a requirement of this configuration is that the frame member, its elements and the hinging or folding methods or mechanisms should be essentially contained within the
20 said members or elements with no protrusion when in the open condition that may disturb the visible planarity of the screen member.

Therefore jointing methods or mechanisms are preferred
25 that have essentially no protrusions outside of the frame elements when the screen member in the open condition yet permits rotation of frame elements relative to each other by up to 180 degrees by creating a real axis that can move outside of the frame section or by a virtual axis of
30 rotation out-with the frame member section and also whereby the increasing gap at the initial movement from the screen member open condition towards the closed condition -as shown previously in figure 3 -will not occur or will be significantly reduced.

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Figure 8 is a cross-sectional view of an example embodiment of an alternative jointing configuration that

combines linear and rotational means to provide an action similar to a virtual axis of rotation present outside of the physical frame elements. The example shown is of a mechanism combining a sliding and hinging action that is contained entirely within the screen frame without protrusion when the screen member is in the open condition and has a reduced gap that opens at the initial closing movements of the screen member. The screen frame elements (8-1) & (8-2) are shown to be partially rotated from an initial in-line position towards a final possible angle of 180 degrees to a position where (8-1) & (8-2) are adjacent and essentially parallel but not necessarily touching. This embodiment uses a hinge type of element (8-3) that is composed of 2 or more parts that have a common central axis (8-4) and where the parts are alternately connected at one end to either the fixed axis (8-6) of (8-1) and at its opposite end to the sliding and pivoting axis (8-5) of (8-2) or the alternate part is connected at one end to the fixed axis (8-6) of (8-2) and its opposite end to the sliding and pivoting axis (8-5) of (8-1). This example embodiment then permits that the hinge element (8-3) can pivot and partially slide its axis (8-4) outside of the frame elements thus permitting rotation of up to 180 degrees between frame elements (8-1) and (8-2) thus acting as if pivoting (8-1) and (8-2) around a virtual axis outside of the frame elements.

Figure 9 is a cross-sectional drawing that shows another embodiment by way of example of a jointing method that achieves the same result as shown in Figure 8, is mechanically simpler as sliding motion is not required and has no increasing gap as also described in Figure 8. This example method operates by the use a single hinge element (9-3) with two parallel axis (9-4) raising perpendicular out of the plane of the drawing such that both elements (9-1) & (9-2) can each rotate independently through essentially 90 degrees relative to hinge element

(9-4) thus acting as a single virtual axis of rotation that moves outside of the frame element cross-section. Element (9-5) is the screen member in cross-section.

- 5 Figure 10 is a cross-sectional drawing that illustrates the above embodiment of Figure 9 with screen frame element (10-2) rotated through 180 degrees relative to screen frame element (10-1) and also shows that the screen member material is constrained to move into a
- 10 lightly rolled or folded position between elements (10-1), (10-2) & (10-3) and whereby the hollow of the hinge element (10-3) is sufficient to avoid pressure or friction against the screen material.
- 15 Figure 4 and Figure 10 when viewed together demonstrate how the material of the screen member (10-5) being held between the upper and lower horizontal frame elements is therefore constrained to fold in a similar manner along lines approximately adjacent to the principal axis of
- 20 rotation shown as (A-A) & (B-B).

Figure 11 is an exploded and partially cut-away perspective drawing that illustrates an embodiment of the detail of the jointing means as illustrated in Figures 9

25 & 10. The screen element (11-5) can be affixed, folded over or bonded to the screen attachment elements (11-6) that can be of a form similar to that shown by either (6A) or (6B). The combined elements of (11-5) and (11-6) can then be located into the screen frame slot as

30 indicated by the arrow (C) of the drawing and if necessary locked in place by other means such as screws (not shown for clarity). Also shown is an optional additional supporting element (11-7) that is also flexible but may be of a stiffer and very durable nature

35 and that may be integral with, or bonded to, the screen member to provide additional mechanical support to the

screen element across the gap of the joint between frame elements (11-5).

Figure 12 is a detailed cut-away perspective view of the assembled hinge assembly as described in Figures 10, 11 & 12.

Figure 13 is a perspective view of the same assembly as Figure 12 and shows for clarity only the screen element (13-5) and a further optional screen material support member (13-7). The intention of this optional screen material support member is that as the screen member moves to the closed condition, the screen material support member will provide additional support to the material of the screen member along the fold line (A-A). As the said screen member closes, the screen material therefore wraps-around the contoured edge (B-B) of the screen material support member and is thus retained in the appropriate shape and contour of the support.

20

The above example embodiments of the jointing methods, have all used sliding or hinging actions or a combination thereof by way of example. Figure 14 provides an example of a different approach using folding methods.

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Figure 14 is a cut-away perspective view of an example embodiment of jointing method for use with the invention using only folding methods. In this example the frame member consists of an essentially in-extensible but flexible supporting band (14-3), the frame elements (14-1) & (14-2) and the optional multiple segments of (14-4). These elements can be either bonded together or made as a single integral flexible part. The elements together effectively operate as a continuous hinge across the location between the rigid sections of frame elements (14-1) & (14-2) and where may be located the segments (14-4). The screen member (14-5) is attached or bonded to

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the band (14-3). Where segments (14-4) are used then a tension spring member (14-6) may pass through the segments (14-1), (14-4) and (14-2) such as to retain the frame elements in the open position and ensure that the curvature between each of the elements is uniform when in the closed position.

The following figures 15 through 21 demonstrate by way of example, embodiments of the screen assembly and their use as part of a visual display device using jointing means as shown in the preceding figures.

Figures 15 through 17 show an example embodiment suitable for use where the screen material is active i.e. contains material or elements capable of producing the light images.

Figure 15 is a perspective view showing in more detail an embodiment similar to the embodiment of Fig 4B in the open condition and wherein four jointing means (15-4) are included to permit a collapsing action around axis (A-A) and (B-B) of the outer frame sections (15-1) & (15-3) and the central section (15-2). A base member (15-6) that acts as a support to retain the screen assembly in the upstanding position is also shown. This base member is also configured as an enclosure. Two possible different closed conditions of the screen sections are shown. In the first, one of the screen assembly outer sections is rotated to 90 degrees as in (15-1) such that when the entire screen assembly is further collapsed towards the enclosure base member about jointing means (15-7) between the base and screen assembly, then the outer screen section falls parallel and adjacent to the sides of the enclosure. Depending on configuration, the outer screen section may be inside or outside of the enclosure. In the second possible closed condition one of the screen assembly outer sections, as shown by (15-3) that is

rotated through 180 degrees such as to be adjacent to the central screen section (15-5).

It can be noted that in case of all of the simple
5 embodiments shown in Figures 2 through 4, the screen assembly is likely to require other support to prevent the frame member trying to collapse itself back into the closed condition. A mechanical support is required for the frame elements or hinges to properly maintain the
10 screen assembly in the open condition. This can be of many forms such as locking mechanisms or the addition of simple spring action within the frame elements to maintain the screen assembly planar and open for viewing. Mechanical support may also be provided by attached
15 panels as is shown in the following embodiment using frame supporting panels.

Figure 16 is a perspective view of the same device as figure 15 in which frame support panel members (16-8, 16-
20 9, 16-10, 16-11, 16-12, 16-13, 16-17) are provided and are attached by jointing means along their front edge to the side upstanding frame element of the outer screen section (16-1) and the upper horizontal frame elements of the screen central section (16-2). The frame support
25 panels may be of a rigid or semi-rigid nature and composed of several sections attached by jointing means along joint lines (as indicated by long dashed lines when not folded and solid lines when folding or folded). The figure also shows that the screen assembly may be mounted
30 on jointing means (16-7) to sliding elements (16-14) and that the lower edge of the screen supporting panels are attached by jointing means to side arms (16-15) that rotate out from the sides of the base about their attachment points (16-16). As is shown by figure 16, when
35 the screen assembly is fully advanced on the slide elements (16-14) away from enclosure, then the side supporting panels (16-8) & (16-17) are constrained to

move outwards by reason of the support panels being attached to the side arms (16-15) that are in turn constrained to pivot outwards. This action pulls the side frame support panels fully open and will constrain the upper frame supporting panels (16-9, 16-10, 16-11, 16-12, 16-13) to move to a common planar position that will effectively support and retain the screen assembly sections in their fully open position and prevent the screen assembly sections from collapsing to the closed condition. It can be noted that the side panels may be used to provide support via the side arms (15) to retain the screen assembly in an upstanding position.

Figure 17 is a perspective view of the same device as in figure 16 whereby the screen assembly is retracted back to be adjacent to the front edge of the base member (17-6). Viewing figures 16 & 17 together, the frame supporting panel elements (17-8, 17-9, 17-10, 17-11, 17-12, 17-13, 17-17) have been collapsed against the screen assembly. The side arms (17-15) are retracted into the base member and their attachment point (17-18) to the side frame supporting elements (17-8) & (17-17) fall adjacent to the axis of the jointing means between the base member and the screen assembly. The joint lines between the upper frame supporting elements (17-10 to 17-11) and (17-11 to 17-12) as shown in figure 17 are immediately adjacent to the axis (A-A) and (B-B) thus permitting that the screen assembly and frame supporting panels may now be collapsed through 180 degrees along the axis (A-A) and (B-B) to the closed condition. The collapsed screen assembly can now be further collapsed around the axis of the jointing means at (17-7) to move from its upstanding position to be enclosed within the base member.

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Figures 18 through 21 show an embodiment of the invention utilising images generated by rear projection methods and

where the screen frame contains two parallel axes for the collapsing of the sections of the screen assembly. The principles of a light shield member (as may be required in rear projection) and a base / enclosure member are also introduced and a further use of the side arms is demonstrated.

Figure 18 is a perspective view of an embodiment of a visual display device similar to figure 16 but using a screen assembly (18-1) with two parallel axes about which the assembly collapses and with a screen member (18-1) of a material suitable for rear projection. A base member configured as an enclosure member (18-3) with lid (18-5) and a light shield member are also shown. The purpose of the light shield member is to eliminate or reduce the ambient light that may impinge on the rear side of the screen member when a suitable screen is employed for rear projection. The light shield may consist of an upper element (18-4), two side elements only one side shown (18-2) and a rear element that in this case is represented by the enclosure lid (18-5). The light shield may be constructed to be of any suitable form or material that is fit for this light shielding purpose and is preferably of a collapsible nature by jointing means between the light shield sections. In the figure 18 the fold lines are shown as dashed lines when unfolded and as solid lines when folded.

It can be noted that the side elements of the light shield may be attached by jointing means along their lower side edges to the side arms that were shown in the previous example embodiment. The front edges of the top and side light shield elements are attached to the screen assembly by jointing means and the front sections of the light shield operate identically to the frame supporting panels of Figure 16 and 17 and thus effectively replace these frame supporting panels in their use to support the

upstanding screen assembly and also retain the screen assembly sections in their open position. It is a further preferable feature that the light shield member is also collapsible and further, it is preferable that the collapsing action of the light shield is of an integral manner therefore not requiring any addition or connection, removal, disconnection or re-location of any parts thereof. It is a further preferable feature that if the light shield is initially collapsed against the screen member such that the light shield may then collapse in an integral manner with the screen assembly towards and into the base member and thus reducing the actions required to collapse the combined assembly. The following figures further demonstrate such embodiments.

15

Figure 19 is a perspective view of the same device as in Fig 18 whereby the top light shield element is hingeably attached to the top edge of the screen assembly along its front edge and is shown folding downwards towards the screen assembly. As it does so, the folding action also causes the front section of the side light shield element (19-2) to fold inwards about its attachment edge with the side of the screen frame member in a similar manner to that shown in figure 16 and 17. This action will also permit that the screen assembly will retract rearwards towards the front top edge of the enclosure member (19-3) and the sides of the light shield member (19-2) will be moved inwards as the side arms, similarly to that of figure 16 and 17, will retract into the sides of the enclosure (19-3).

30

Figure 20 is a perspective view of the same device as in Fig 19 whereby the top light shield member (20-4) has folded downwards against the screen assembly and in doing so has folded completely the front section of the side light shields (20-2 -not shown) behind and against the screen assembly into a position similar to that of figure

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17. It may be noted again that as in the device explained in Figure 17, the device the fold lines of the upper element of the top light shield element should be immediately adjacent to the parallel fold lines of the screen assembly as prescribed by the screen frame axis and thus permitting the combined light shield and screen assembly to fold together in the direction of the arrows indicated to a closed position at 90 degrees to the original open position.

10

Figure 21 is a perspective view of the same device as in Fig 20 whereby the screen assembly sections and light shield sections have rotated about the two parallel axis to approximately 90 degrees. The combined light shield and screen assembly can now be collapsed again into its final position adjacent to the enclosure by hinging rearwards about the joints connecting it (via the slide elements similar to figure 16) to the base member (21-3). When collapsed completely, the outer sections of the screen assembly will be adjacent to the outer surface of the sides of the enclosure (21-3) and the central section of the screen assembly (21-1) is adjacent and approximately flat and parallel with the top of the enclosure (21-3). The means of collapsing of the remaining side sections of the side light shield elements (21-5) can be of many forms and an example of this can be by a simple concertina folding action defined by fold lines forming triangular elements with a common apex coincident with the axis of rotation between the screen assembly and the base member. The lid of the enclosure can be configured so as to partially or completely enclose the screen assembly when the lid is itself closed.

35 It is desirable in any screen member embodiment that it will permit the screen assembly to collapse or deploy in an integral and self-supporting manner. Figures 15

through 21 show that the screen assembly (and any attachments thereto such as the light shield) can move as a complete assembly between the open condition and the closed condition and do so by a single action or short series of actions that relate only and directly to the opening or closing actions and without need for any disconnection or detachment or removal or re-location or addition or connection or re-connection of any element or member. Means such as springing action may be included further assisting the individual assemblies or frame supporting panel elements to be self-supporting.

With particular reference to the embodiments described in Figures 15 through 21, it can be further noted that opening or closing actions of the screen assembly of the invention can be executed by user intervention or by inherent mechanisms (such as springs) or by an external drive (for example by means of motorisation) that may also be attached to the base member or enclosure to further maintain or control the position of the frame supporting elements or be used for motorising the action of opening and closing of the screen assembly and/or light shield assembly.

The next series of figures demonstrate the use of non-parallel axes of folding of the screen assembly and provides example embodiments utilising these principles.

Figure 22 is a perspective view of a collapsed screen assembly similar to that presented in previous figures and using two parallel axes of collapsing. Also indicated are a further set of hinge elements (22-4) that define a third axis (C-C) perpendicular to the two existing parallel axes.

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Figure 23 is a perspective view very similar to that of Figure 22 that illustrates a further embodiment whereby

the top section of the screen assembly (23-3) can hinge down as a secondary collapsing action and whereby the further folding action occurs about a further axis (C) that is at 90 degrees to the original two parallel axes of collapsing. This secondary collapsing action can be performed by use of jointing means at (23-4) that may have features similar to those illustrated in Figures 7 through 13. The arrow (23-5) represents the movement downwards from the original position at a 90 degree position (A) and this movement may be continued down to a final position at approximately 180 degrees shown by the dotted lines (B). The screen fold edges have potential pinching or crushing points that may occur on the fold lines (23-6) and (23-7) of the screen member (23-6) due to this secondary rotation towards the final closed condition.

In reference to Figure 23, it is evident that additional support to the screen member is required in the case of the above described secondary collapsing condition to avoid pinching or crushing actions and this support can be similar to or based on the principles outlined within the description of Figure 14 with an additional means to be described in the following figure.

Figure 24 is a perspective cut-away view of an arrangement similar to that of Figure 14. This illustrates a particular further embodiment of the proposed screen material support member (24-1) whereby it can be composed with a different material, thickness or physical configuration such that a flexible section (24-2) of the screen material support element may easily bend around a virtual axis (A-A). This axis and thus the flexible section (24-2) should be located as part of the support member (24-1) such that this position coincides with the line of folding of the screen member material (24-3) such as to be adjacent to the axis (C-C) of

figures 22 and 23 and thus situated between the points (24-6) to point (24-7) of Figure 23.

Figure 25 is a cut-away and exploded perspective view of part of the screen material (25-3) and the screen material support (25-1) at the critical positions shown as points (23-6) & (23-7) of figure 23 which arise due to the secondary collapsing action as described above 23. The screen material (25-3) and screen material support member (25-1) are in reality in contact but are shown to be separated in this figure for reasons of clarity. A grid has been drawn for clarity on the surface of the flexible section (25-2) such that the resulting shape of the screen material supporting member is understood and the form that the screen material will adopt along the fold line (C-C) at the contact with the contoured edge of the screen material support member (B-B).

The jointing means (23-4) of figure 23 can be of a similar nature to those described in Figures 9 through 13 but large enough to accommodate the outer diameter of curvature of the screen and screen material support members when in the closed condition as shown in Figure 25.

Referring to the screen material (25-3) shown in Figure 25, the inner and outer radii of curvature, the flexibility of the screen element and its tension within the collapsed frame should be such that the additional tension of being stretched over the outer surface of the folded section (25-2) will not cause optical or mechanical damage to the screen element and also that the reduction in tension on the inside surface of the folded section (25-2) will not permit undue wrinkling or pinching of the screen material.

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Figures 26 through 30 provide an example embodiment of a screen assembly having two parallel axes and a third

perpendicular axis of collapsing and its use within a visual display device being activated by rear projection methods.

5 Figure 26 is a perspective view of a screen assembly similar to that shown in figure 22 being attached by jointing means on its lower side to a base (26-1) that can be positioned on a flat surface and is used to maintain the screen assembly upstanding when in the open
10 position. This view shows the base may also be in the form of an enclosure with a lid (26-2) (shown in partial cut-away).

Figure 27 is a perspective view of the same device as
15 Figure 26 showing a frontal view of the screen member (27-5) in the open condition. A light shield member is shown to be attached or adjacent to the frame member (27-3) and extends rearwards and downwards to be attached or adjacent to the base member (27-1) by means of its sides
20 (27-7) & (27-9) and top (27-8). As explained previously in figure 18 and 19, the front sections of the top and side light shield elements due to their being in a common plane and at an angle to the frame hinging axis effectively act as frame supporting panels and also
25 assist in retaining the frame and screen assembly sections in their open position. If the base (27-1) is configured as an enclosure, it can be seen that where a lid of the enclosure is present and supported by the addition of hinging mechanisms to the rear of the
30 enclosure (27-4), then the said lid may be used to act as the rear section of the light shield member and/or as a support thereto.

In further reference to Fig 27 it can be noted that in
35 the situation where the base member (27-1) is configured as an enclosure then this enclosure may also retain the projection device for rear projection either integrally

within the enclosure or as a removable unit or as an attachment to the said base or enclosure member. The inner surface of the rear light shield or lid member (27-2) may support or have affixed to its inner surface a mirror member (27-6) to reflect images from the projector unit to the screen member. In the case of the projector being integrally mounted within the enclosure member, then an aperture (27-10) can be mounted in the enclosure such that a mirror affixed to the aperture will direct the light path of the projector to the screen member, possibly via another mirror, when the aperture is closed and when open will permit that the light path of the projector be allowed to exit the enclosure for front projection on a remote surface.

Figure 28 is a view of the same device as in Figure 27 but from a rear perspective and shows the enclosure (28-1) and that the lid of the enclosure (28-2) that also act as part of the light shield member (28-3). This embodiment will, in the following figures, demonstrate a further example of an integrally collapsing light shield member (however different in configuration from the previously shown embodiment of figure 16) whereby the folding or hinging action occurs along the folding lines indicated in the drawing by long dash lines (until folded it is thereafter represented by a solid line). The following figures describe the operation of this collapsing light shield member and how it also collapses integrally with the screen assembly.

Figure 29 is a view of the same device as in Figure 28 but with the enclosure lid (29-2) partially cut-away for clarity and showing the light shield member elements (29-1 through 6, elements on the remote side of drawing are symmetrical positioned but not identified for clarity). The upper light shield elements (29-4), (29-5) & (29-6) are attached to the corresponding elements of the upper

frame elements (29-7). The front edges of light shield element (29-1) are attached to the upstanding side frame element (29-8). The side faces of the light shield member (29-1) & (29-2) when drawn towards the screen member as shown by the arrows, will cause the upper side light shield element (29-3) to fold inwards around the upper edge that is attached to the outer edge of upper element (29-4). This action also causes the light shield elements (29-4), (29-5) & (29-6) to rotate around their common axis of attachment with the top of the screen member (29-7) and thus rotate in a downward direction and thus also towards the rear face of the said screen member.

Figure 30 is a view of the same device as in Figure 29 and with the aforesaid light shield member fully collapsed against the rear face of the screen assembly. It should be noted that the fold lines between the light shield elements (30-1 to 30-2) and (30-4 to 30-5) and also the previous lower edge of element (30-3) are all parallel and immediately adjacent to the axis of folding of the screen assembly. This permits that the outer screen assembly sections may still collapse as a combined assembly of the screen assembly with the light shield member to a closed condition by collapsing through 180 degrees about the axis (A-A) and (B-B) in the direction of the arrows (30-10) & (30-11) to the collapsed configuration similarly to that as described in previous figures.

A preferable embodiment of the light shield member would permit that the elements of the light shield when collapsed flat with the screen assembly as shown in figure 30 would together form a composite curved surface around which the screen element will roll into a fold along the axis (A-A) and thus act identically to the screen material supporting members previously described as element (24-1) of Figure 24 and 25. The following

figure further demonstrates how the light shield members by use of folding or flexible areas of their elements can be folded within the collapsing screen assembly and act as screen supporting members.

5

Figure 31 is a horizontal cross-sectional view through the lower frame member according to the direction of arrow (C) of figure 30. This cross-section is on a horizontal plane and shows schematically the most complex
10 part of the combined collapsed assembly. The figure contains an upper and a lower view of the open and closed conditions respectively. The cross-section of the screen member is shown in black to differentiate it from the cross-sections of the various other light shield members
15 in close proximity. For clarity, the areas of the light shield that are rigid or semi-rigid are shown in single hatching and the areas that are flexible such as the fold area at connection of (31-1 to 31-2) and the fold area at the connection of (31-4 to 31-5) are shown by cross-
20 hatching.

Continuing with the closing action of the assembly as described in Figure 30 and 31, the screen assembly can now be considered to be collapsed along with the light
25 shield member to its closed condition similar to that previously shown in Figure 22. The upper section of the combined screen assembly and light shield member can now be collapsed around the perpendicular axis as shown in Figure 23 by using similar methods of co-incidental fold
30 lines on the light shield and the methods of Figures 24 and 25 whereby the light shield effectively takes the place of the screen material supporting elements of Figures 24 and 25. This action completed, the doubly collapsed combined assembly can now also be retracted
35 into the enclosure member as similarly shown in Figure 26.

Mechanisms may also be attached to the base member or enclosure to further maintain or control the position of the frame elements or be used for motorising the actions of opening and closing of the screen assembly and possibly in combination with the actions to collapse the combined screen assembly and light shield assembly as described in Figures 29, 30 & 31.

Figure 32 is cross-sectional view along a vertical plane passing longitudinally through the centre of a device that may be considered similar to that as described in Figure 26 and exposing by way of example a suitable internal arrangement of the device. The screen assembly comprises of the screen member (32-1) and frame elements (32-2) & (32-3) and is hingeably mounted to the base (32-4) configured as a carrying case and also containing a mirror (32-5) mounted on an aperture door (32-6), a removable projector unit (32-7), a lid (32-8) to which is attached a further mirror (32-9). The front and sides of the lid (32-10) are attached by jointing means to the main lid section (32-8) such as to extend forward and outwards to act as a part of the existing light shield (32-11). The case also contains slides (32-12) permitting the lid to slide outwards and rearwards from the case to permit enough distance between the screen and projector along the light path (shown as dashed lines). An optional member of the case may be an audio system (not shown) and a module bay (32-14) for media such as for example TV, DVD player, memory card (i.e a PC-Card) or say a disc based memory device .

Figure 33 is a perspective view of a possible embodiment with the screen member (33-1) in the open condition and showing the visual display device incorporating an audio system (33-2) and "plug-in" modules (33-3) to provide image media such as by a DVD player or Television tuner or PC-card or similar media source and a removable

projector unit (33-4). The format of the enclosure with all elements collapsed therein is shown as item (33-5).

Within the scope of the above described embodiments,
5 "hinges" or "hinging", "folds" or "folding", "rotates" or
"rotating" can be considered to generally refer to
mechanisms or any material or mechanical property that
permits that members, elements or parts thereof can move
in an rotating manner relative to one another around a
10 common real or virtual axis and whereby "slide" or
"sliding" can be considered to generally refer to any
material or mechanical property that permits that
members, elements or parts thereof can move in any linear
or longitudinal manner.

15

It will be appreciated that while particular embodiments
of the invention have been shown and described,
modifications may be made. It is intended in the
following claims to cover all such modifications that may
20 fall within the true spirit of the invention.

CLAIMS

1. A screen assembly for a portable visual display device comprising a frame member to which is permanently
5 attached a screen member for the presentation of visual images on a front viewing surface by diffusion of optical images created to the rear of this front viewing surface wherein the screen assembly comprises at least two screen and frame sections connected by jointing means such that
10 the screen assembly is deployable into an open condition for visual display and collapsible into a closed condition in such a manner as to significantly reduce the screen member area when in the closed condition.
- 15 2. A screen assembly as claimed in claim 1, wherein the material of the screen member is active such that images are created and diffused from within the screen member.
- 20 3. A screen assembly as claimed in claim 1, wherein the material of the screen member is of a translucent nature suitable for the diffusion of optical images projected through the screen member from a projection device located to the rear of the screen
25 member.
4. A screen assembly as claimed in claims 1, 2 or 3, wherein the screen member comprises rigid or semi-rigid material.
- 30
5. A screen assembly as claimed in claim 1 or 2, wherein the screen member comprises flexible material.
6. A screen assembly as claimed in any preceding
35 claim, wherein the screen assembly is composed of a screen member retained within a screen frame member

having jointing means thereon such that any section of the screen assembly may fold about one or more axes determined by the jointing means in such a manner as to significantly reduce the screen member area when in the closed position.

7. A screen assembly as claimed in any preceding claim wherein a screen and frame section, determined by the frame jointing means, may rotate about the jointing means through approximately 180 degrees into a flat position adjacent other screen and frame sections.

8. A screen assembly as claimed in any preceding claim wherein the screen and frame sections may rotate about the jointing means such that a screen section lies substantially perpendicular to other screen and frame sections.

9. A screen assembly as claimed in any preceding claim wherein the screen frame member is provided with screen frame supporting panels that are attached by jointing means to the edges of the screen frame such as to provide mechanical support to the screen assembly when in the open condition and to lie flat with the screen member or sections thereof when in the closed condition.

10. A screen assembly as claimed in claim 3, wherein the screen member comprises flexible material.

11. A screen assembly as claimed in claim 10 wherein the screen assembly is composed of a screen member of a flexible material retained within a screen frame member having jointing means thereon such that any section of the screen assembly may fold about one or more axes determined by the jointing means in such a manner as to significantly reduce the screen member frontal planar area when in the closed position.

12. A screen assembly as claimed in claim 10 or 11, wherein a screen and frame section, determined by the frame jointing means, may rotate through approximately 180 degrees into a flat position adjacent to the other
5 screen sections.

13. A screen assembly as claimed in one of claims 10, 11 or 12, wherein the screen and frame sections may rotate by jointing means about the frame axis enabling
10 outer screen sections to rotate so that the said outer sections are perpendicular to the remaining screen sections when in the closed condition.

14. A screen assembly as claimed in one of claims 15 10 through 13 wherein the screen frame member has attached to it, screen frame supporting panels that are attached by jointing means to the screen frame elements such as to provide mechanical support to the screen
20 assembly when in the open condition and to lie flat with the screen member or sections thereof when in the closed condition.

15. A screen assembly as claimed in claim 9 or claim 14 wherein some or all of the axes of rotation of
25 the jointing means between frame supporting panels are configured to fall essentially parallel and co-incident or adjacent to axes of the jointing means of the screen assembly when the frame support members are closed flat
-- against the screen member.

30

16. A screen assembly as claimed in any preceding claim wherein sections of the screen assembly may rotate about at least two axes one of which is not parallel to
any other axis.

35

17. A screen assembly as claimed in any preceding claim wherein sections of the screen assembly may rotate

about at least two axes of which at least two are essentially parallel.

18. A screen assembly as claimed in any preceding claim, wherein sections of the screen assembly may rotate about two parallel axes and a third perpendicular axis.

19. A screen assembly as claimed in any preceding claim wherein the jointing means comprise axes of rotation that are virtual or pseudo-virtual or are axes that may move out of the physical section of the frame elements or jointing means.

20. A screen assembly as claimed in any preceding claim wherein the screen assembly is configured to deploy to the open condition or collapse to the closed condition as a complete and integral assembly by direct action about the jointing means without need for the disengagement or re-engagement or re-location of any of the sections thereof.

21. A screen assembly as claimed in any one of claims 5 to 20 wherein the screen assembly has attached screen material support members that can be brought into a position adjacent and parallel to the axis of rotation of the screen assembly sections such as to act as a support or guide to the screen member material as it wraps around the screen material support member during the rotation of the screen assembly sections during the closing action and when in the closed condition.

22. A portable visual display device comprising a screen assembly in accordance with any preceding claim wherein the screen assembly is mounted to a base member suitable for seating on a flat surface such that the base member provides support to retain the screen assembly in an upstanding position when in the open condition.

23. A portable visual display device as claimed in claim 22 wherein the base member is configured as an enclosure and comprises mechanisms to assist or execute the opening or closing of the screen member.

5

24. A portable visual display device as claimed in claim 22 or 23, wherein the base member is configured to serve as an enclosure member and is hingedly attached to the screen assembly such that the collapsed screen assembly may retract at least in part into the enclosure.

10

25. A portable visual display device as claimed in one of claims 22, 23 or 24 wherein the base member is configured to serve as an enclosure member and is provided with hinging elements to the screen assembly such that outer sections of the screen assembly that lie perpendicular to central sections of the screen assembly in the closed condition are brought to a position parallel and at least in part adjacent to the side walls of the enclosure member when retracted within the enclosure member in the closed condition.

15

20

26. A portable visual display device as claimed in one of claims 22 through 25 wherein the base member includes image projection means.

25

27. A portable visual display device as claimed in claim 26, wherein the projection means are installed integrally or installed as a removable unit.

.-

30

28. A portable visual display device as claimed in claim 27 wherein the base member is configured as an enclosure containing an integrally installed projection means and whereby the enclosure comprises an aperture positioned to allow a light path to leave the visual display device such that the device may be used for frontal projection onto a remote screen.

35

29. A portable visual display device as claimed in one of claims 26 through 28 wherein the enclosure member comprises a mirror or mirrors disposed to fold back the light path between projection means and screen member.

5

30. A portable visual display device as claimed in one of claims 23 through 29 whereby the enclosure further comprises a lid to protect the display device.

10 31. A portable visual display device as claimed in claim 30 wherein the enclosure lid supports a mirror.

32. A portable visual display device as claimed in one of claims 23 through 31, further comprising a collapsible light shielding member which is deployable in the open condition so as to be adjacent or attached to the upper horizontal and side upstanding frame elements of the screen assembly and to extend downwards and rearwards towards the base member.

20

33. A portable visual display device as claimed in claim 32 wherein the base member is configured as an enclosure with a lid such that the enclosure lid when open acts as a part of the light shield.

25

34. A portable visual display device as claimed in claims 32 or 33 wherein the light shielding member is jointed to the screen assembly such that it is collapsible from the open and deployed condition to a collapsed condition adjacent to the screen assembly.

30

35. A portable visual display device as claimed in claim 34 wherein the light shielding member or any part or element thereof is jointed to a screen frame edge and acts as a frame supporting panel such as to provide mechanical support to the screen assembly when in the open position.

35

36. A portable visual display device as claimed in claim 34 or 35 wherein the light shielding member or any part or element thereof acts as a screen material support member that can be brought into a position adjacent and parallel to the axis of rotation of the screen assembly sections such as to act as a support or guide to the screen member material as it wraps around the screen material support member during the rotation of the screen assembly sections during the closing action and when in the closed condition.

37. A portable visual display device as claimed in one of claims 34 through 36 wherein the light shielding member is configured to collapse in a secondary collapsing movement in co-operation with the collapsing movement of the screen assembly such that the combined device collapses to a closed condition.

38. A portable visual display device as claimed in claim 37 wherein the axis of collapsing of the screen assembly and the secondary axis of collapsing of the light shielding member are parallel and adjacent or coincidental.

39. A portable visual display device as claimed in claim 38 wherein the combined screen assembly and light shielding member retract together to be enclosed at least in part within the enclosure member.

40. A portable visual display device as claimed in one of claims 32 through 39 wherein the light shielding member includes side light shield elements mounted on hinge or slide members that enable the side light shield elements to pivot out from the side edges of the enclosure such that the side light shield elements then extend outwards to be adjacent to the screen assembly or frame supporting panels.

AMENDED CLAIMS

[received by the International Bureau on 3 September 1999 (03.09.99);
original claims 1-40 replaced by amended claims 1-34 (7 pages)]

1. A collapsible rear projection screen assembly
for a portable visual display device comprising a
5 flexible viewing screen member that is held to be flat by
its permanent attachment to the four sides of a
surrounding rectangular, self supporting frame member
composed of rigid frame elements and wherein the screen
assembly comprises at least two sections connected by
10 jointing means such that the screen assembly is
deployable into an open condition for visual display and
collapsible into a closed condition in such a manner as
to significantly reduce the screen member area when in
the closed condition.

15

2. A screen assembly as claimed in claim 1,
wherein the viewing screen attachment means and the
screen frame jointing means are essentially contained
within or mounted on a rear non-visible surface of the
20 screen frame elements.

3. A screen assembly as claimed in claim 1 or 2,
wherein the viewing screen member and the screen frame
elements comprise flexible supporting elements that may
25 be additional parts or integral elements of the screen
attachment means that provide support to the viewing
screen member across any gaps in the attachment means
associated with the jointing means between the screen
frame elements.

30

4. A screen assembly as claimed in one of claims
1, 2 or 3, wherein a rear surface of the jointing means
facing or contacting the viewing screen material
comprises a hollow area.

35

5. A screen assembly as claimed in any preceding claim, wherein the jointing means, the screen frame member and the screen attachment means are configured to permit the screen member material to roll into a lightly rolled fold as the screen sections rotate around the axes of the jointing means to avoid damage to the physical or optical properties of the material of the viewing screen member during movement between the open and closed conditions.

10

6. A screen assembly as claimed in any preceding claim, wherein the jointing means between screen frame elements comprise axes of rotation that are virtual or pseudo-virtual or are axes that may move out of the physical section of the frame elements or jointing means.

7. A screen assembly as claimed in any preceding claim, wherein the screen assembly includes attached fold-guide elements that can be brought into a position adjacent and parallel to the axis of rotation of the screen assembly sections such as to act as a support or guide to the screen member material as it folds around the fold-guide element during the rotation of the screen assembly sections during the closing action and when in the closed condition.

8. A screen assembly as claimed in any preceding claim, wherein a screen and frame section, determined by the frame jointing means, may rotate about the jointing means through approximately 180 degrees into a flat position adjacent other screen and frame sections.

9. A screen assembly as claimed in any preceding claim, wherein the screen and frame sections may rotate about the jointing means such that an outer screen section lies substantially perpendicular to any other screen and frame sections when in the closed condition.

10. A screen assembly as claimed in any preceding claim, wherein sections of the screen assembly may rotate about at least two axes of which at least two are essentially parallel.

11. A screen assembly as claimed in any preceding claim, wherein sections of the screen assembly may rotate about at least two axes of which one is not parallel to any other axis.

12. A screen assembly as claimed in any preceding claim, wherein sections of the screen assembly may rotate around two parallel axes and a third perpendicular axis.

13. A screen assembly as claimed in claim 11 or 12 when additionally dependent on claim 7, wherein two axes of rotation of the screen sections intersect, the fold-guide members are configured to fold or bend in a controlled and parallel manner with the second intersecting axis of rotation such that the edge of the fold guide member and the screen material that is wrapped around it will curve into a "U" shape and whereby the edge of the base of this "U" forms an approximately semi-toroidal shape such as to permit the wrapped viewing screen material to effectively fold in two planes without pinch points or stress damage.

14. A screen assembly as claimed in any preceding claim, wherein frame supporting panels are attached by jointing means to screen frame elements such that the frame supporting panels lie flat and adjacent with the screen sections when in the closed condition and open outwards in the open condition towards an approximate perpendicular position relative to the open screen

placing on any suitable surface such that the base member provides support to retain the screen assembly in an upstanding position when in the open condition.

5 20. A visual display device comprising a screen assembly as claimed in claim 19, wherein the base member is configured to serve as an enclosure member and is hingedly attached to the screen assembly and the base enclosure member such that the collapsed screen assembly
10 may retract at least in part into the base enclosure member.

 21. A visual display device comprising a screen assembly as claimed in claim 20, wherein the base
15 enclosure member comprises a lid to protect the display device.

 22. A visual display device comprising a screen assembly as claimed in claim 20 or 21, wherein the base
20 enclosure member comprises mechanisms including mechanical or motorised means to assist or execute the opening or closing of the screen assembly.

 23. A visual display device comprising a screen
25 assembly as claimed in one of claims 20 to 22 when additionally dependent on one of claims 15 to 17, wherein the frame supporting panels are connected to the base member such as to provide mechanical support to the screen assembly to retain it in the upstanding position
30 and/or provide support to the screen assembly during deployment to or from the upstanding position.

 24. A portable visual display device as claimed in one of claims 19 to 23, wherein the base member includes
35 image projection means attached thereto.

25. A portable visual display device as claimed in one of claims 20 to 23, wherein the projection means are installed integrally or installed as a removable unit.

5 26. A portable visual display device as claimed in claim 25, wherein the base enclosure member comprises an aperture positioned to allow a light path to leave the visual display device such that the device could be used for frontal projection onto a remote screen.

10 27. A portable visual display device as claimed in one of claims 20 to 26, wherein the base enclosure member comprises a mirror or mirrors disposed to fold back the light path such as to reduce the physical distance from
15 the projection means to the viewable screen member.

28. A portable visual display device as claimed in any preceding claim, wherein a collapsible light shielding member is deployable in the open condition so
20 as to be adjacent or attached to the upper horizontal and side upstanding frame elements of the screen assembly and extend downwards and rearwards towards the base member or projection device.

25 29. A portable visual display device as claimed in one of claims 21 to 28, wherein the enclosure lid acts as a light shielding member when in the open condition.

30 30. A portable visual display device as claimed in claim 28 or 29, wherein the light shielding member is jointed to the screen assembly such that it is collapsible from the open and deployed condition to an initial collapsed condition adjacent to the sections of the screen assembly.

35 31. A portable visual display device as claimed in claim 30, wherein the axis of collapsing of the screen

assembly and the secondary axis of collapsing of the light shielding member are parallel and also adjacent or co-incidental.

5 32. A portable visual display device as claimed in claim 31, wherein the combined screen assembly and light shielding member retract together to be enclosed at least in part within the enclosure member.

10 33. A portable visual display device as claimed in claim 31 or 32, wherein the collapsed light shielding member acts wholly or partially as a fold-guide element that can be brought into position adjacent and parallel to the axis of rotation of the screen assembly sections
15 such as to act as a support or guide to the screen member material as it wraps around the fold-guide element during the rotation of the screen assembly sections during the collapsing action and when in the closed condition.

20 34. A portable visual display device as claimed in one of claims 31 to 33, wherein the light shielding member is jointed to a screen frame edge and acts as a frame supporting panel such as to provide mechanical support to the screen assembly when in the open position.

STATEMENT UNDER ARTICLE 19

Following reception of the International Search Report, amendments have been made to the claims for the following reasons:

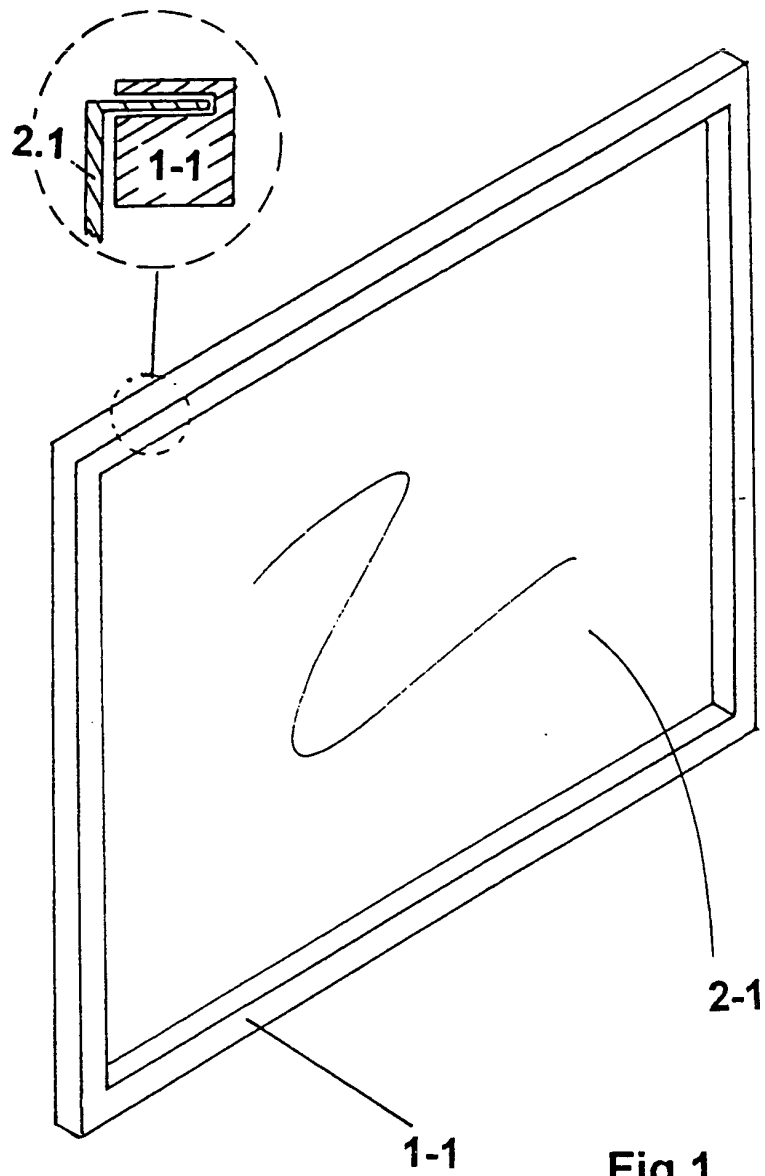
- To limit the patent application to only flexible, rear projection screens;
- To narrow the scope to the main inventive elements by discarding the more general claims that may conflict with prior art;
- As a result of the above two points, to define a narrower end use of the Invention (see below) and amend previous claims accordingly; and
- To better clarify the main inventive elements within the new and amended claims.

The intended use of the invention is (use now relating only to rear-projection):

An autonomous visual display device comprising a large self-collapsible rear projection screen that can be placed directly on a person's desk or meeting room table and used for portable / mobile presentations of a business, professional, promotional, marketing, advertising, communication, training or educational nature. Presentations can also be made to many people situated in all normal indoor environments such as in typical business environments, meeting and training rooms, offices, classrooms, lecture-rooms, exhibition halls, point-of-sale areas, gymnasiums etc,

The presentation screen collapses within the display device enclosure that has possibly the appearance and size of an executive attache case –suitable for carrying from room to room or for travelling from place to place. Presentations can be started and viewed within 10-15 seconds of arrival, independent of the environment, on the seam-less, flat screen with images available across the entire screen surface within the screen frame. Due to the screen configuration, its area can be several times larger in operation than when retracted into its carrying case. The operation of this visual display device is simple and the opening and closing operations can be fully motorised.

A possible embodiment of the invention is as an optional accessory to conventional projectors.



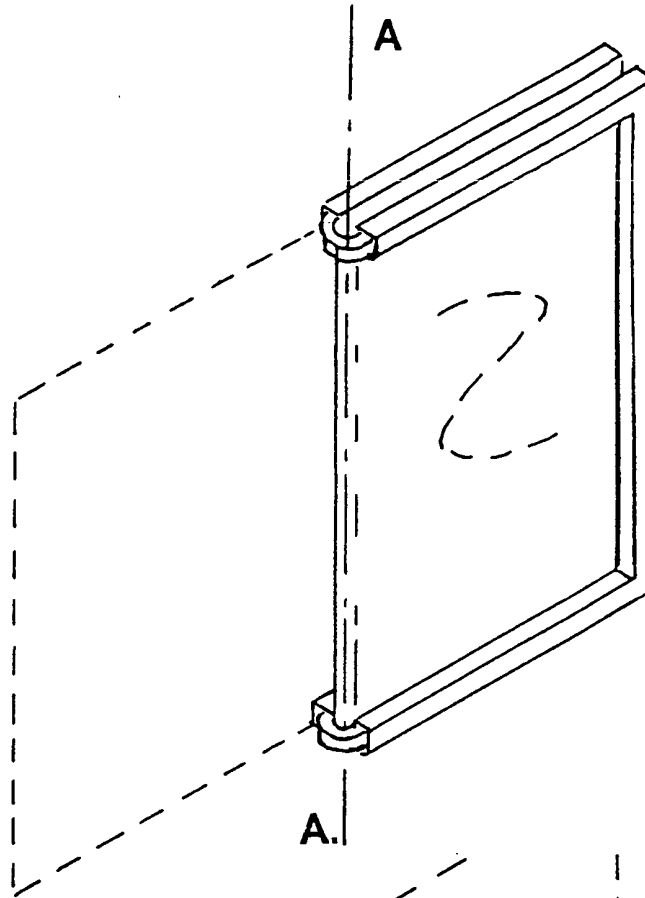


Fig 2b

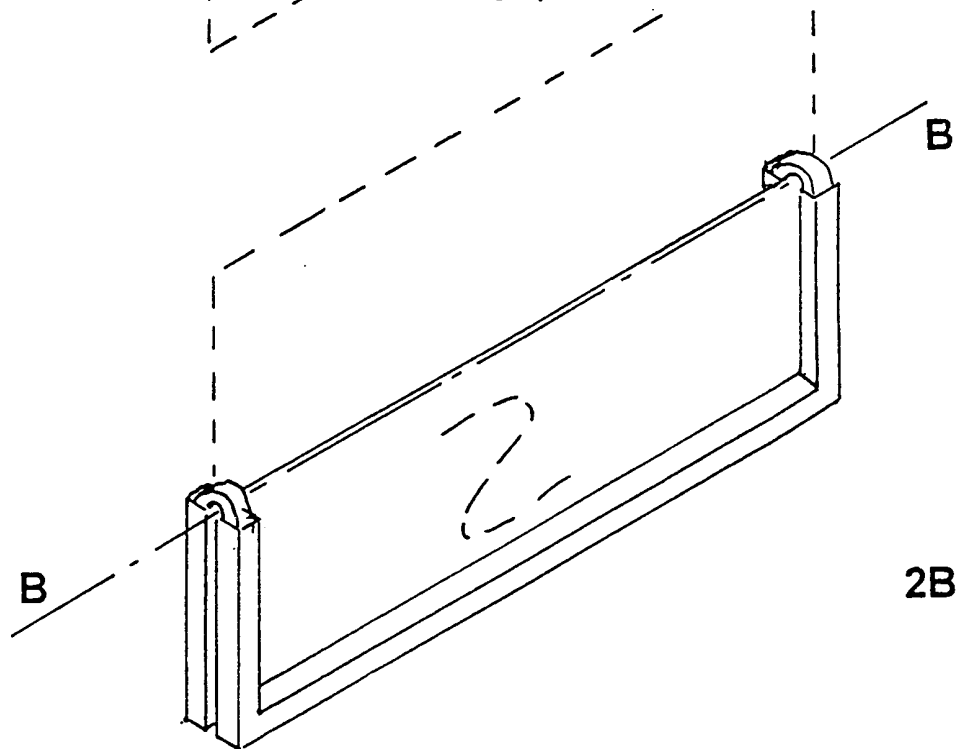


Fig 2a

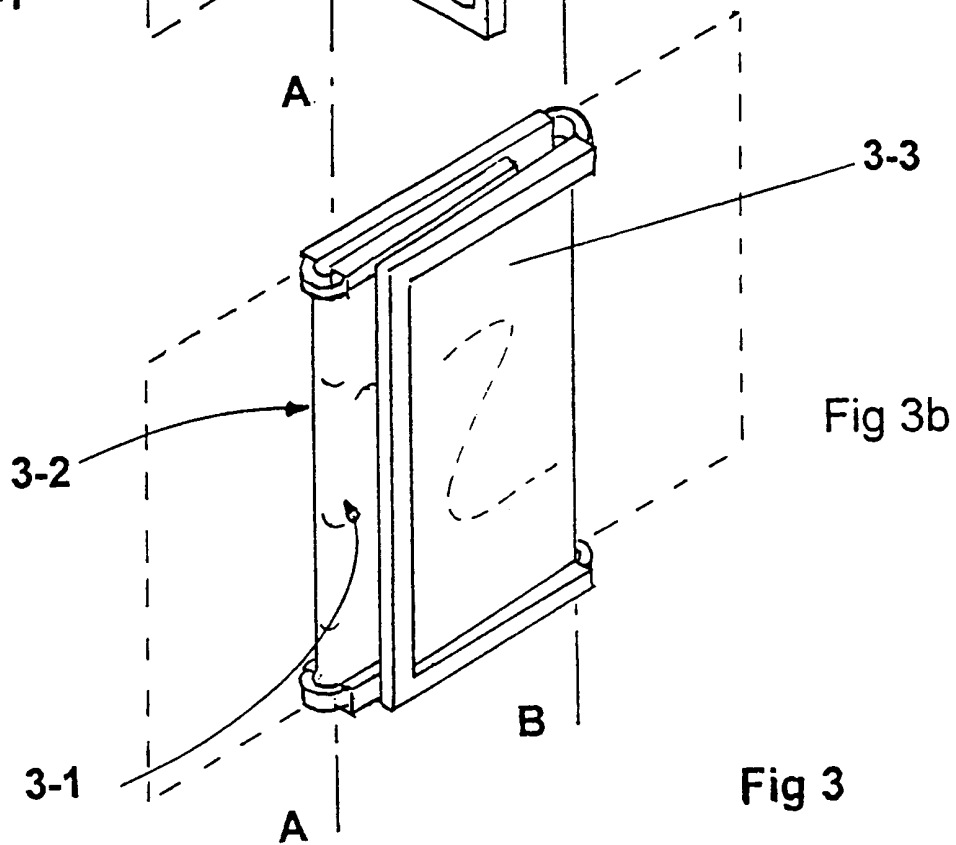
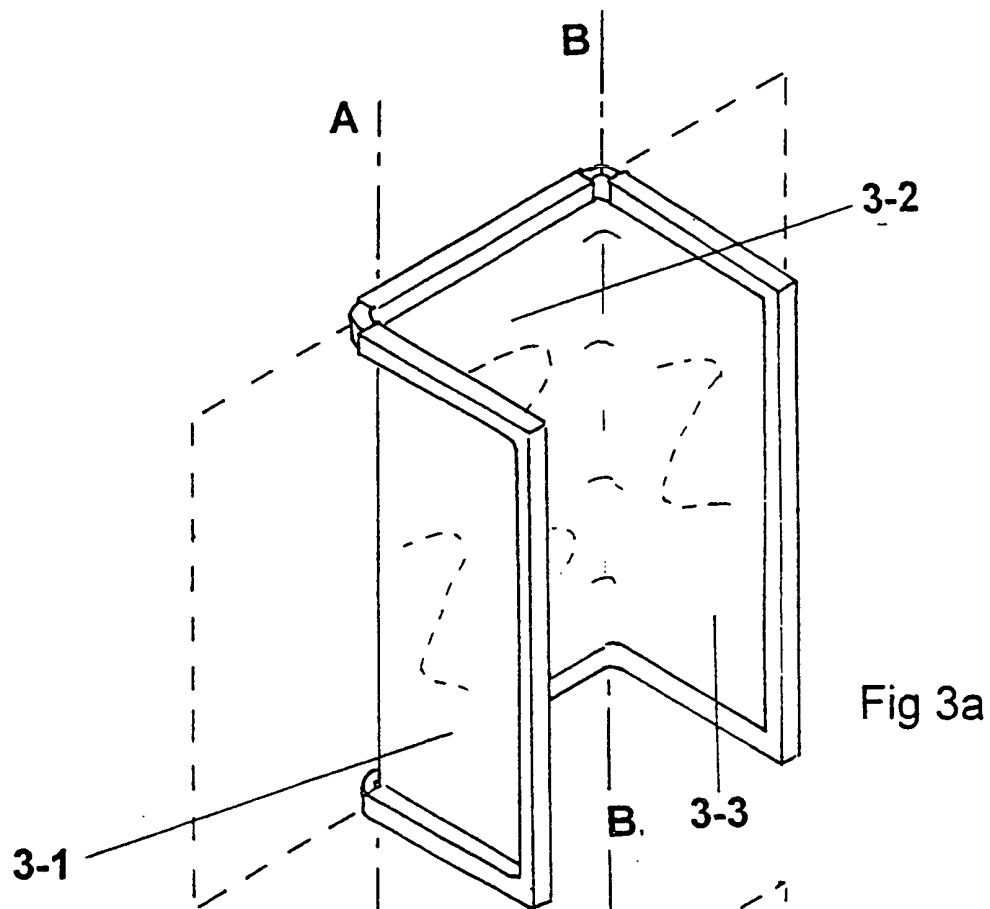


Fig 3

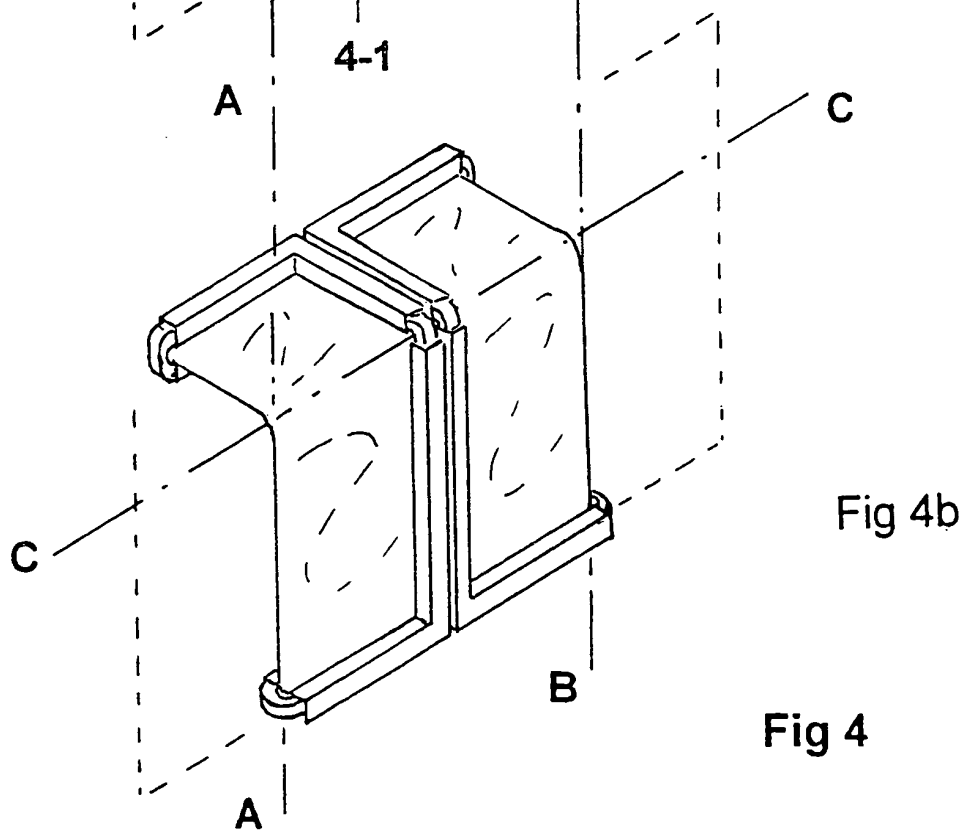
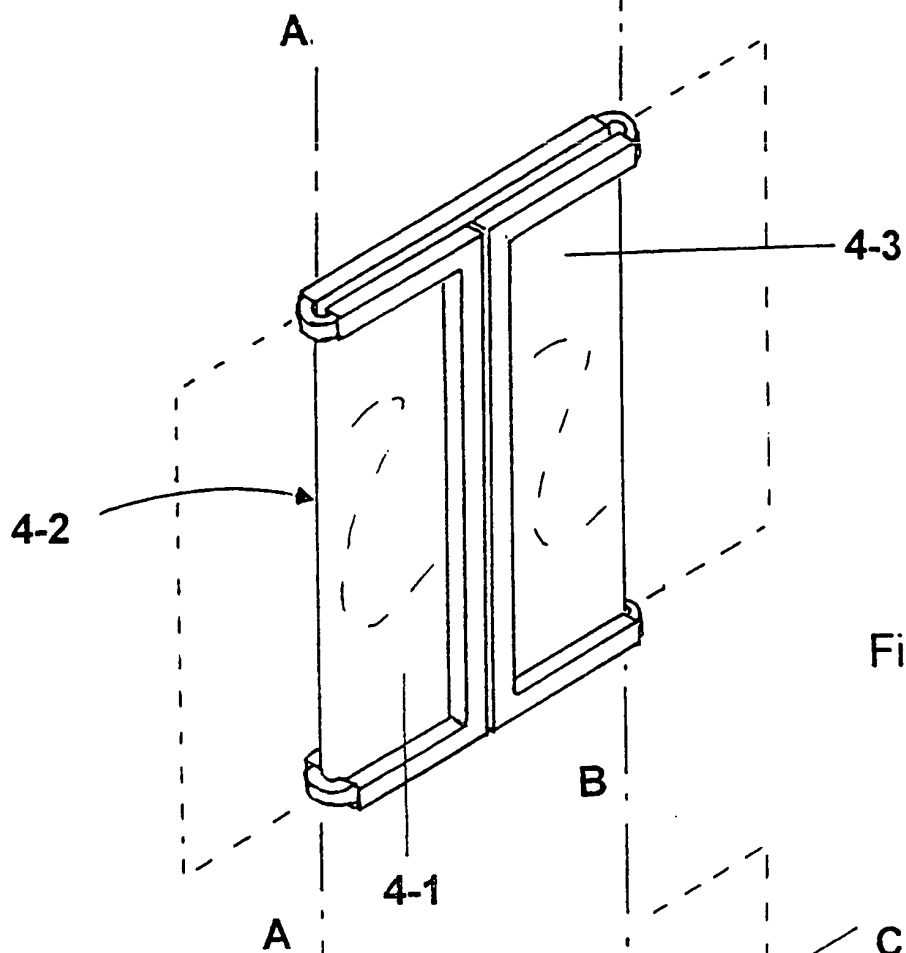


Fig 4

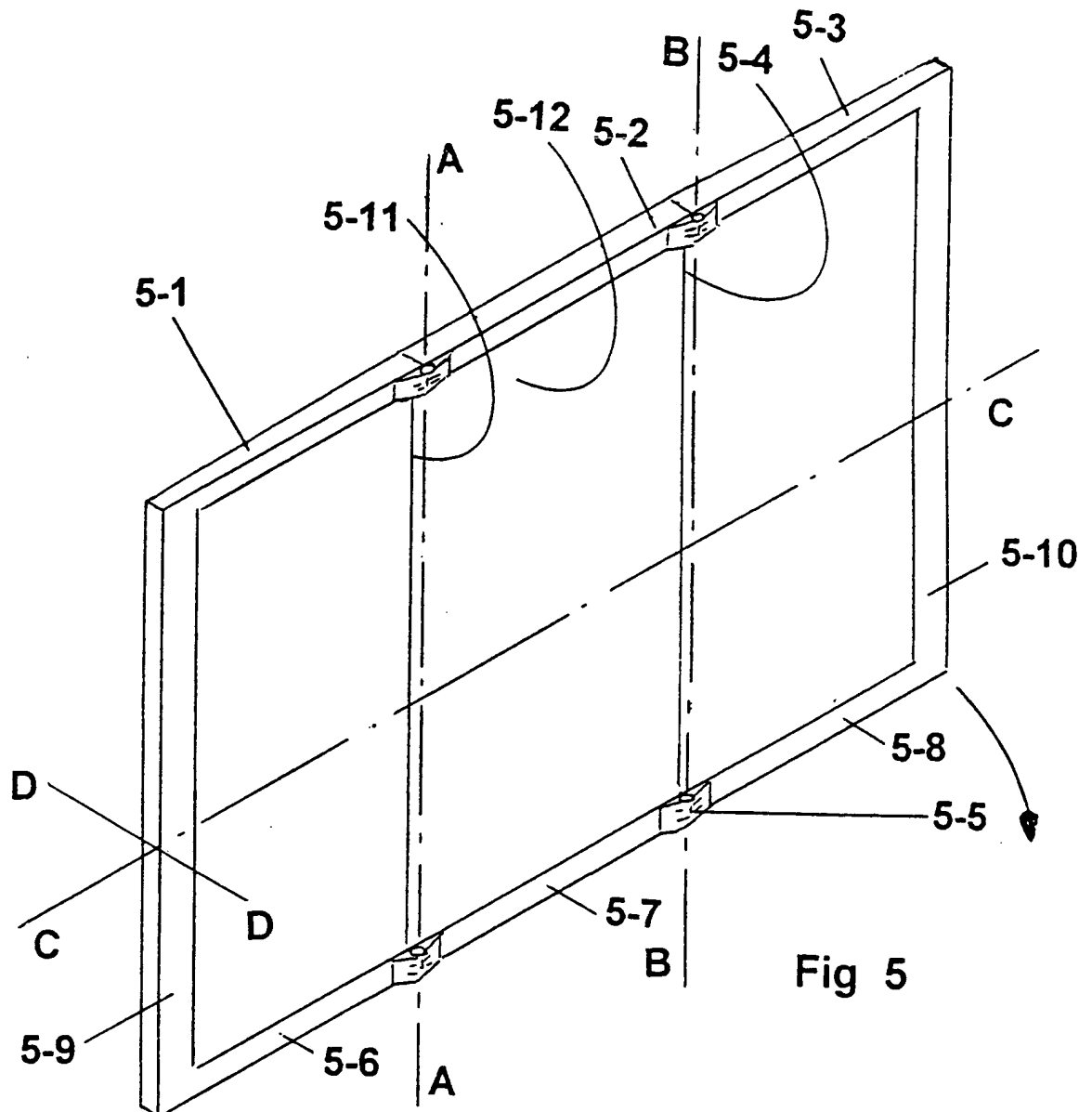


Fig 5

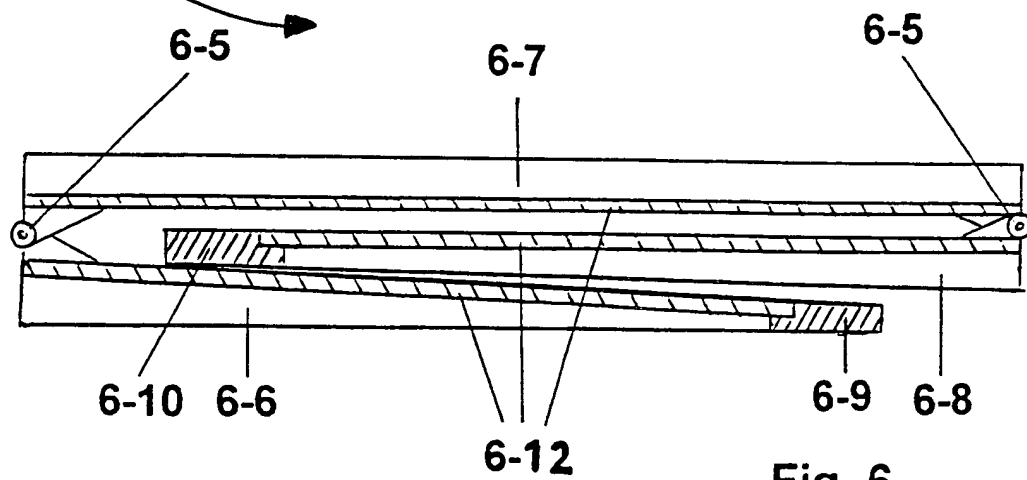


Fig 6

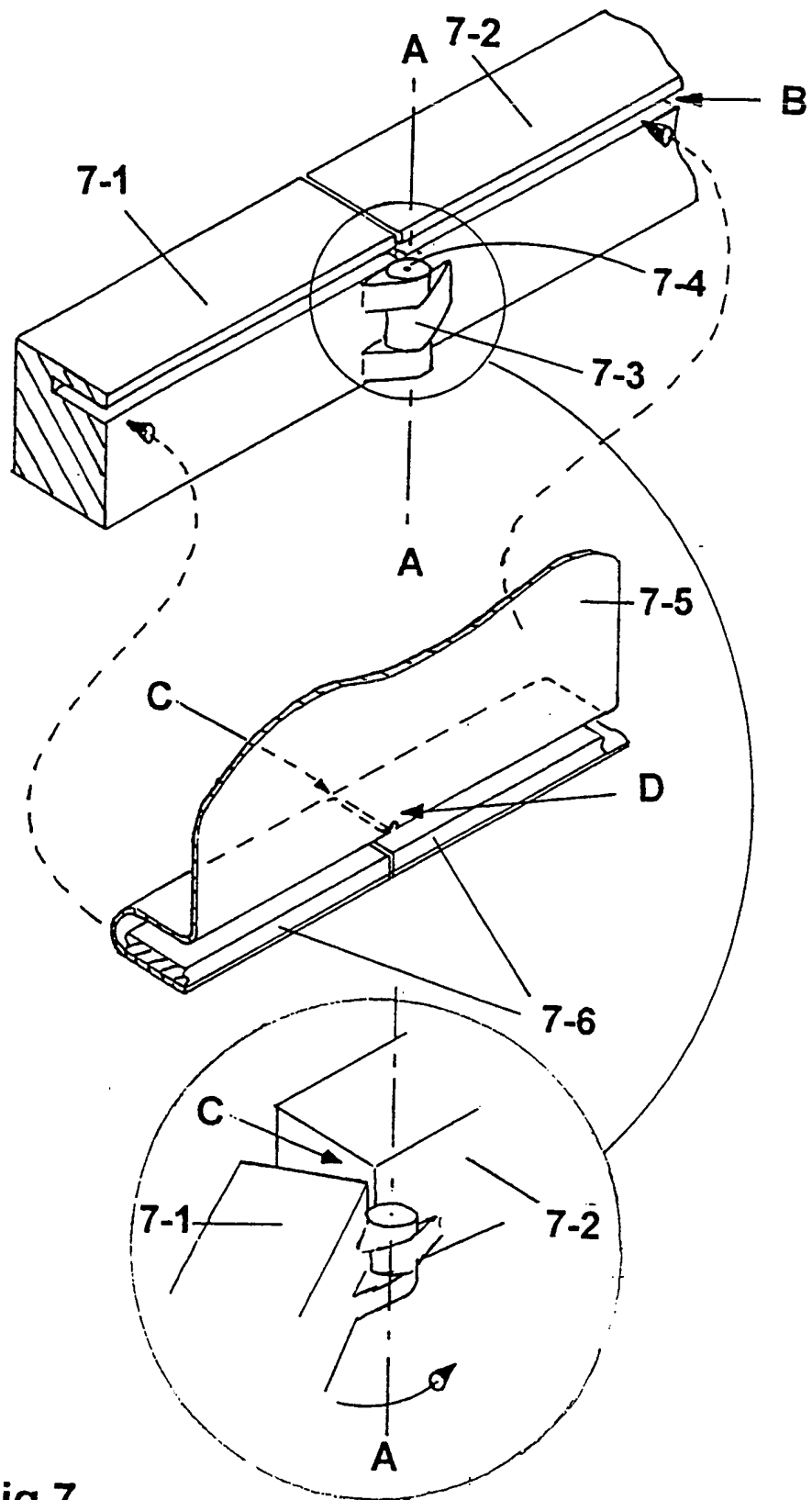
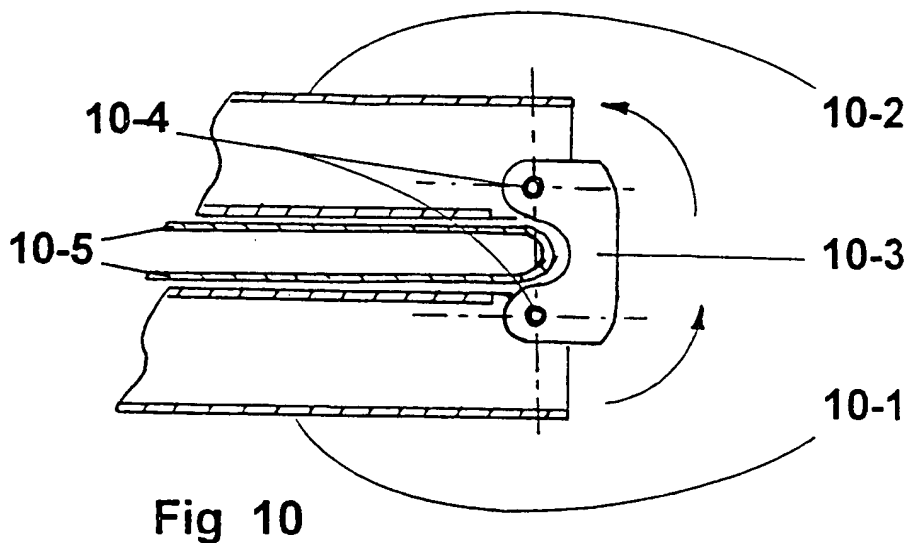
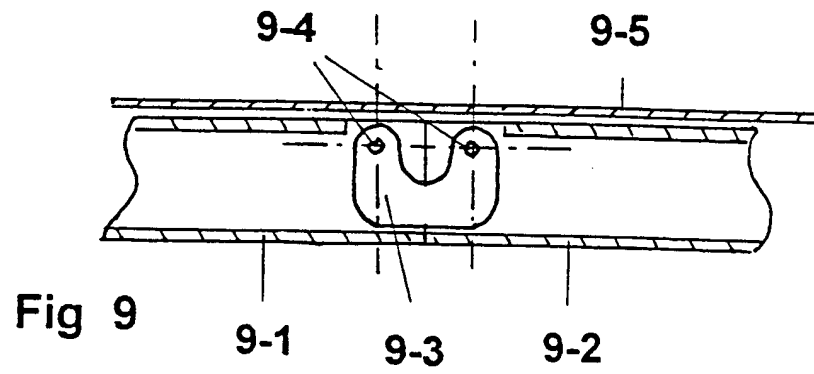
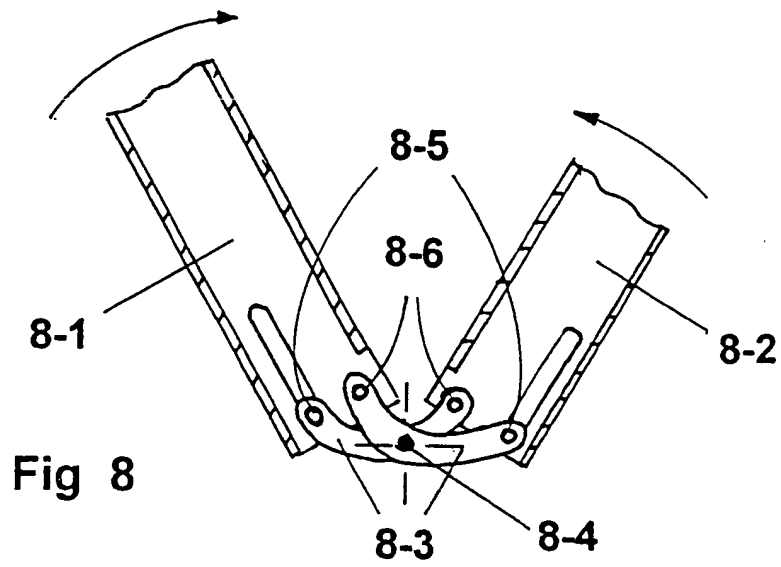


Fig 7



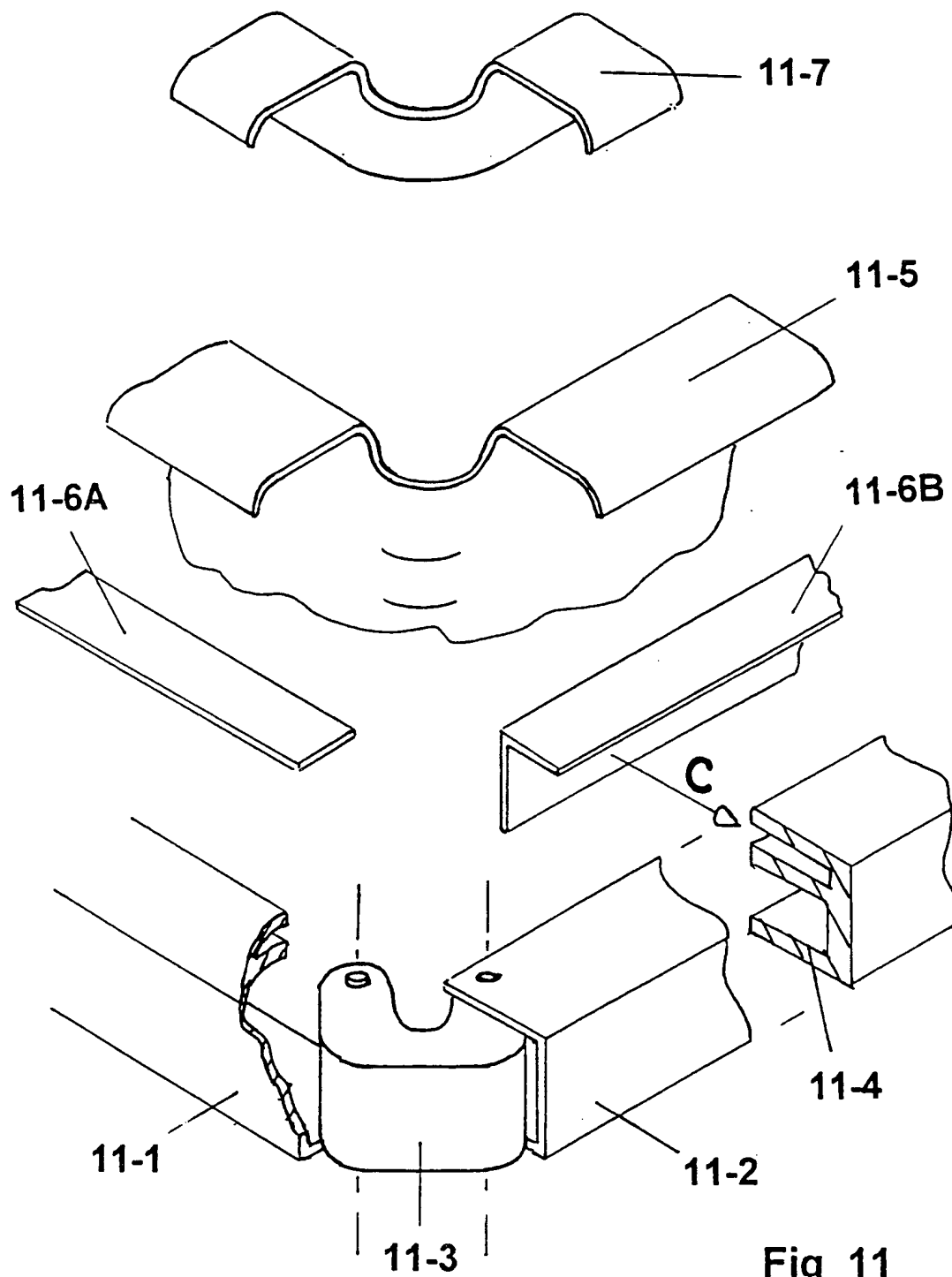
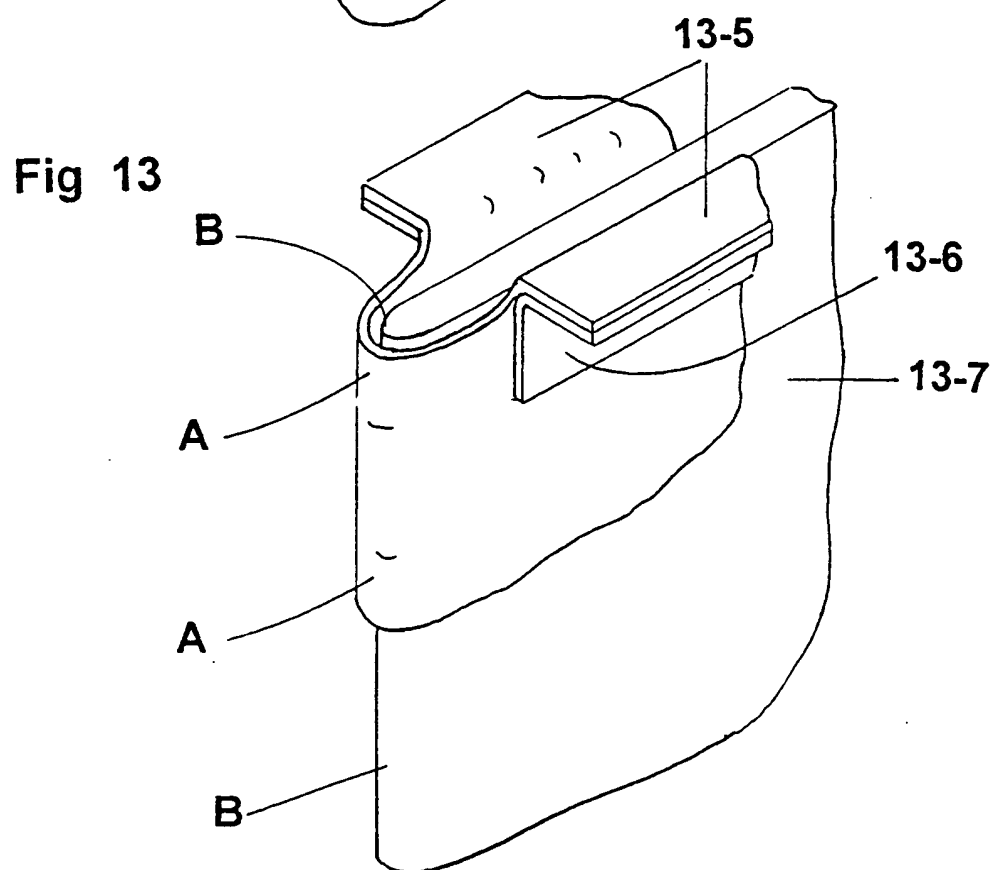
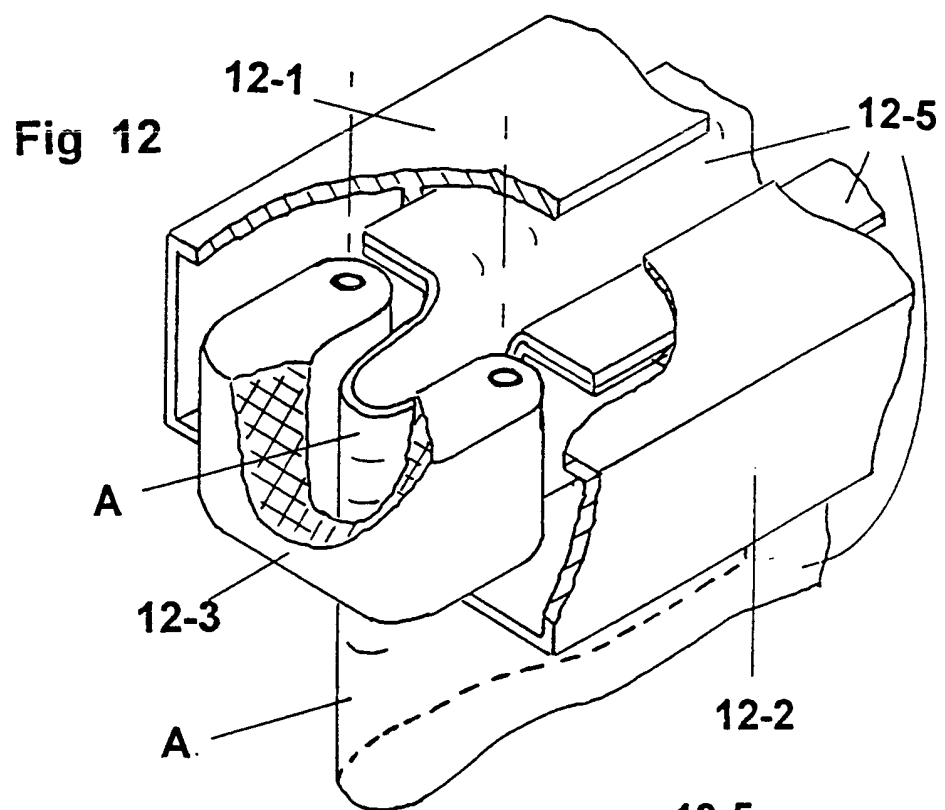


Fig 11



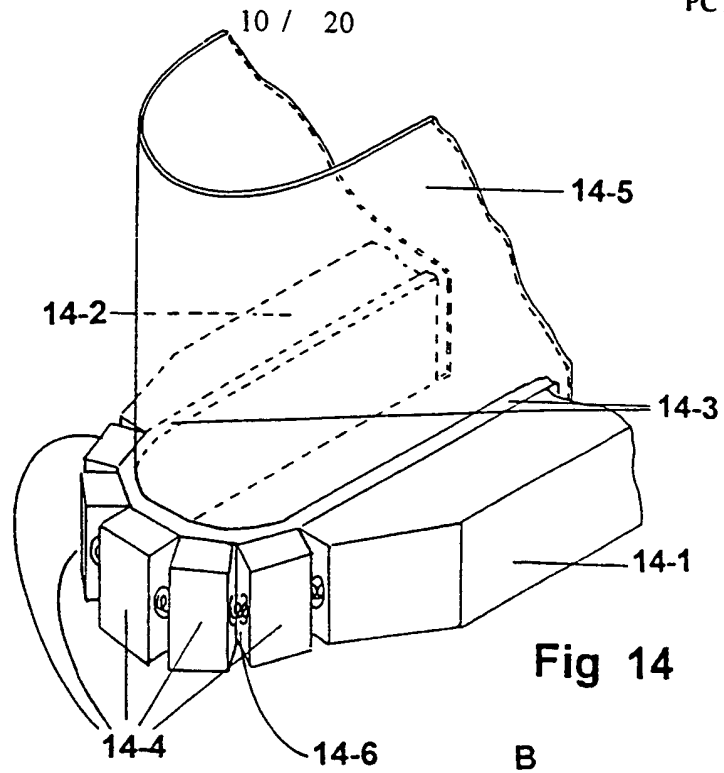


Fig 14

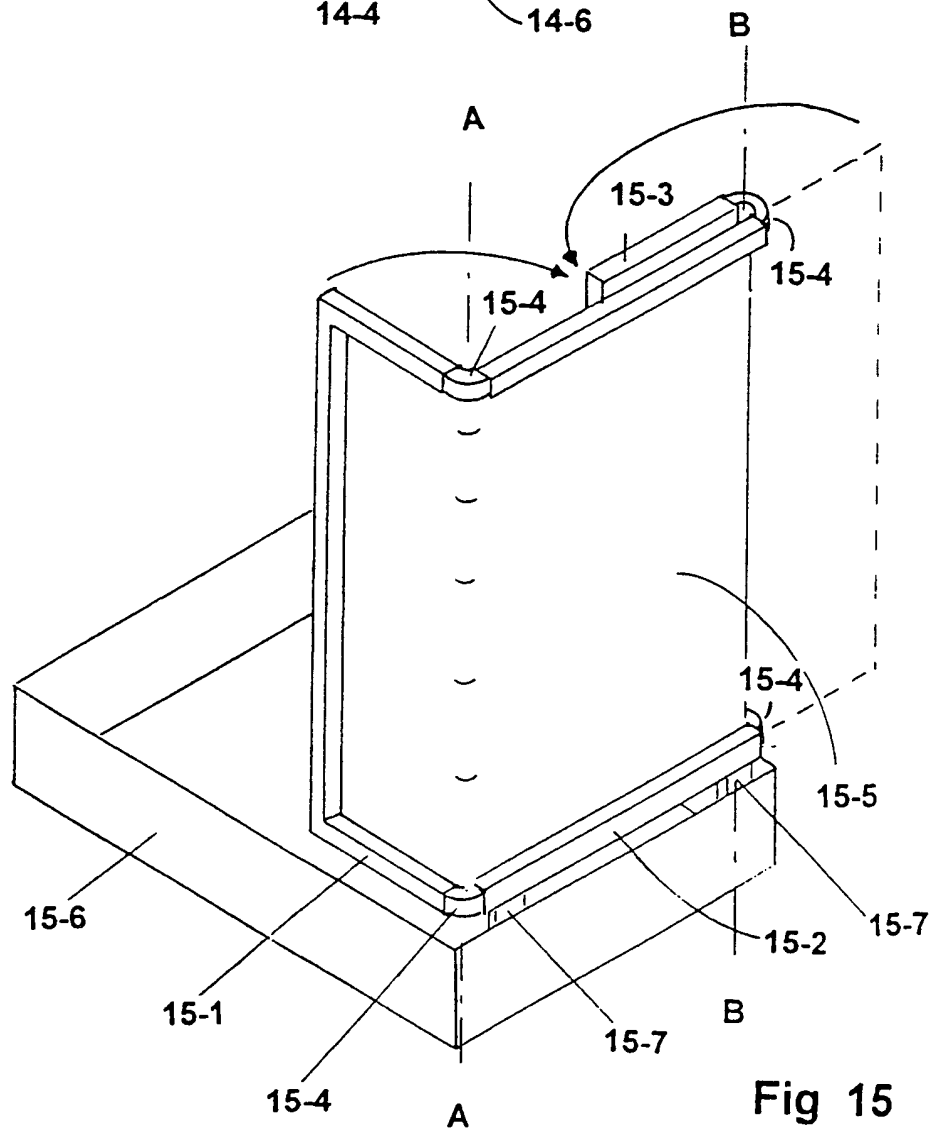


Fig 15

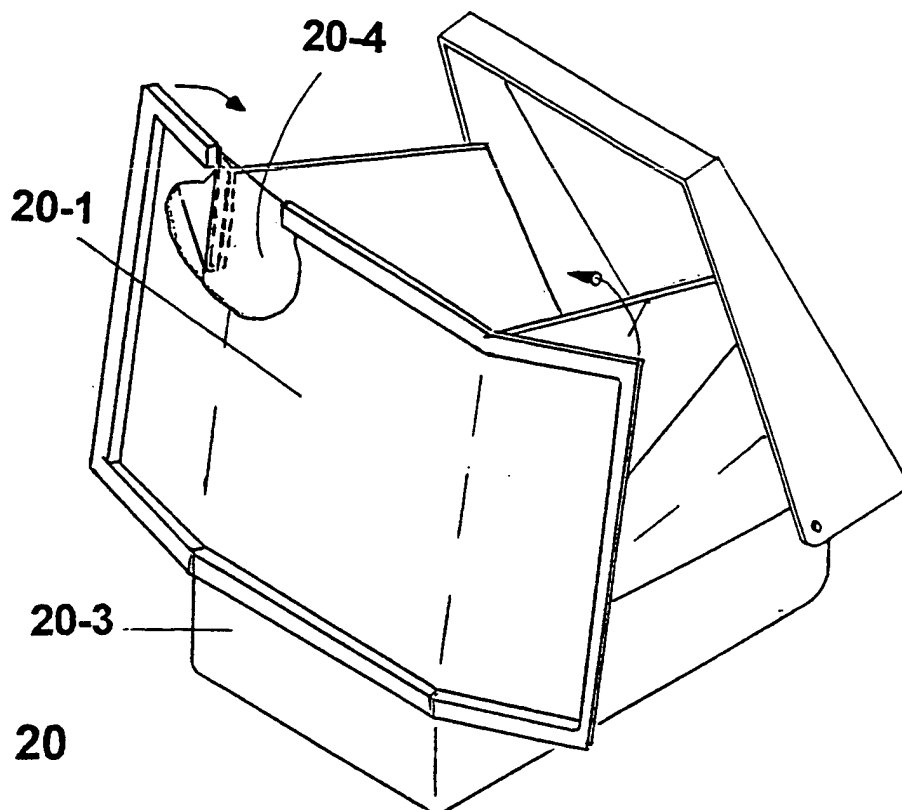


Fig 20

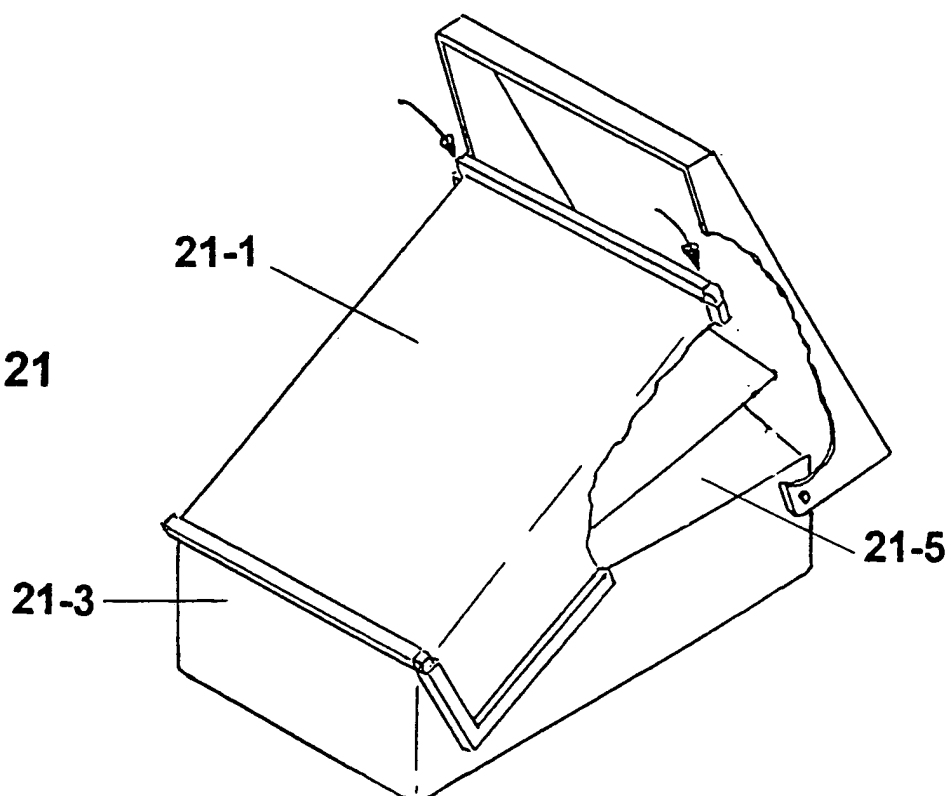


Fig 21

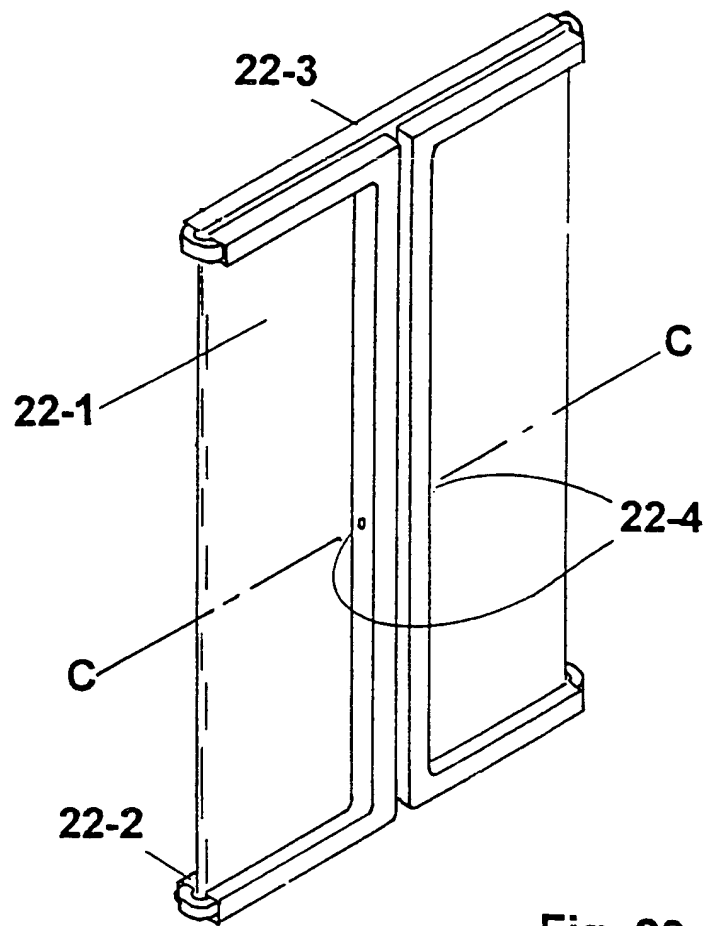
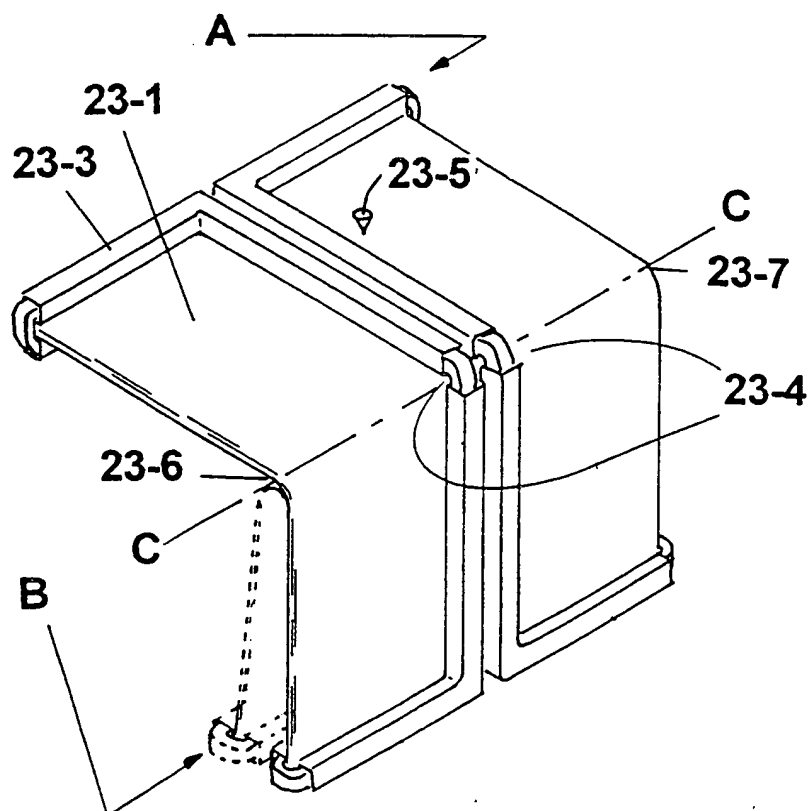
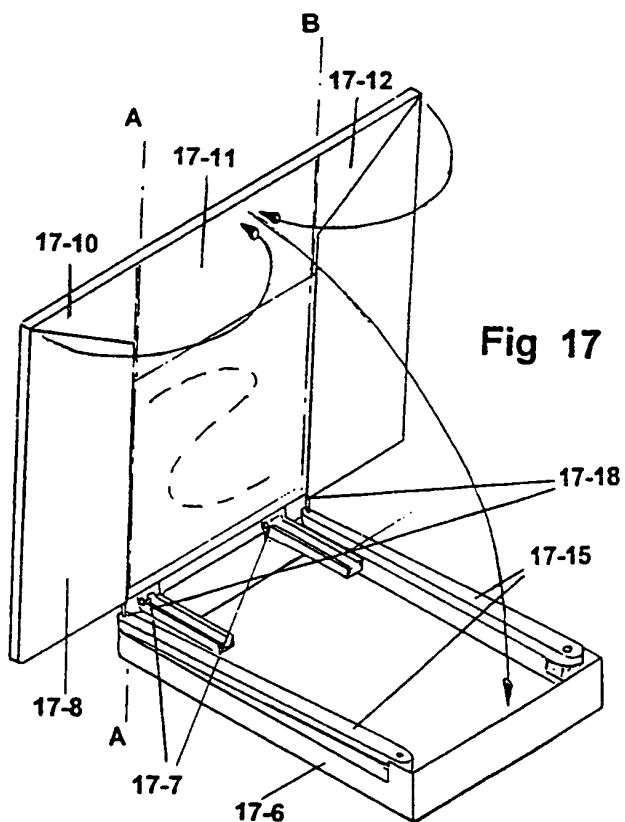
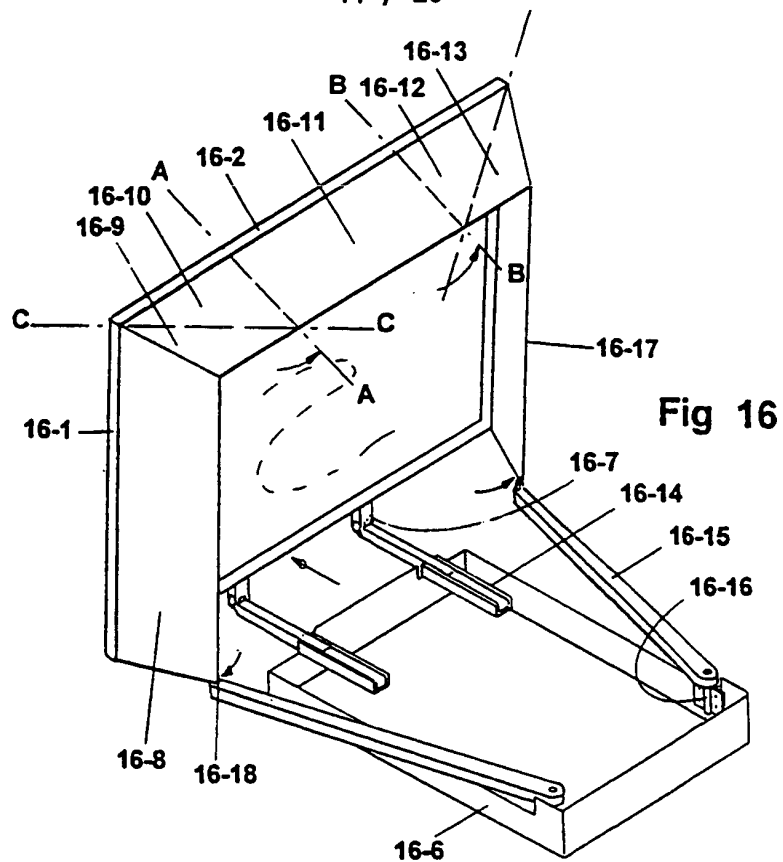


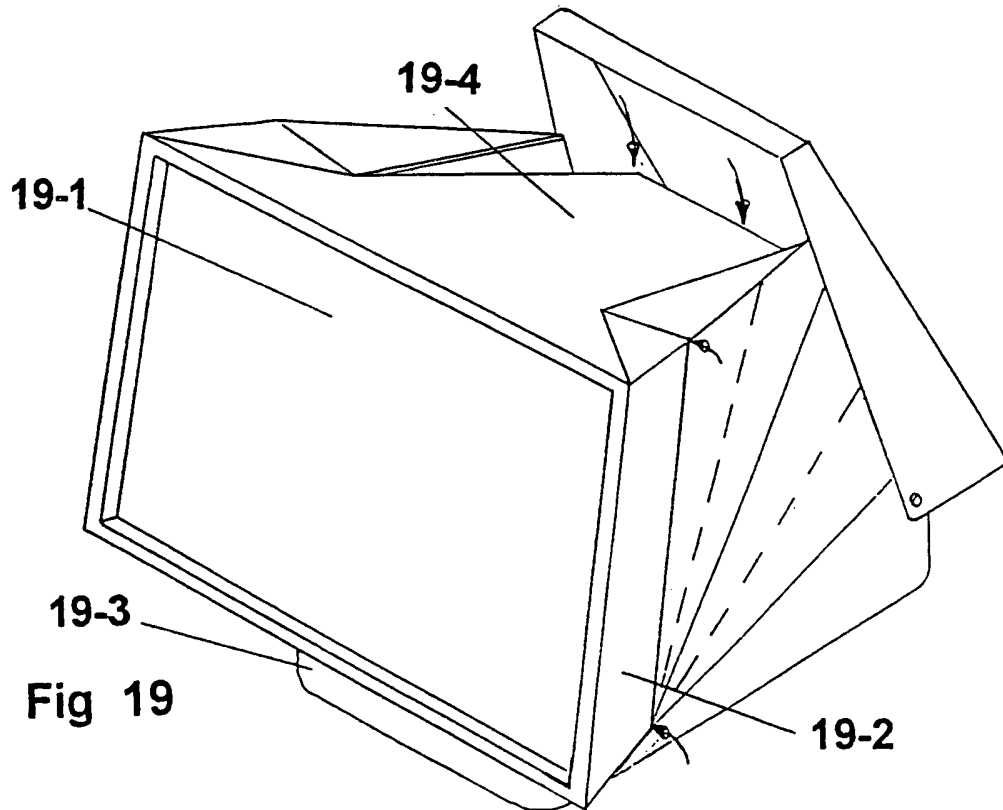
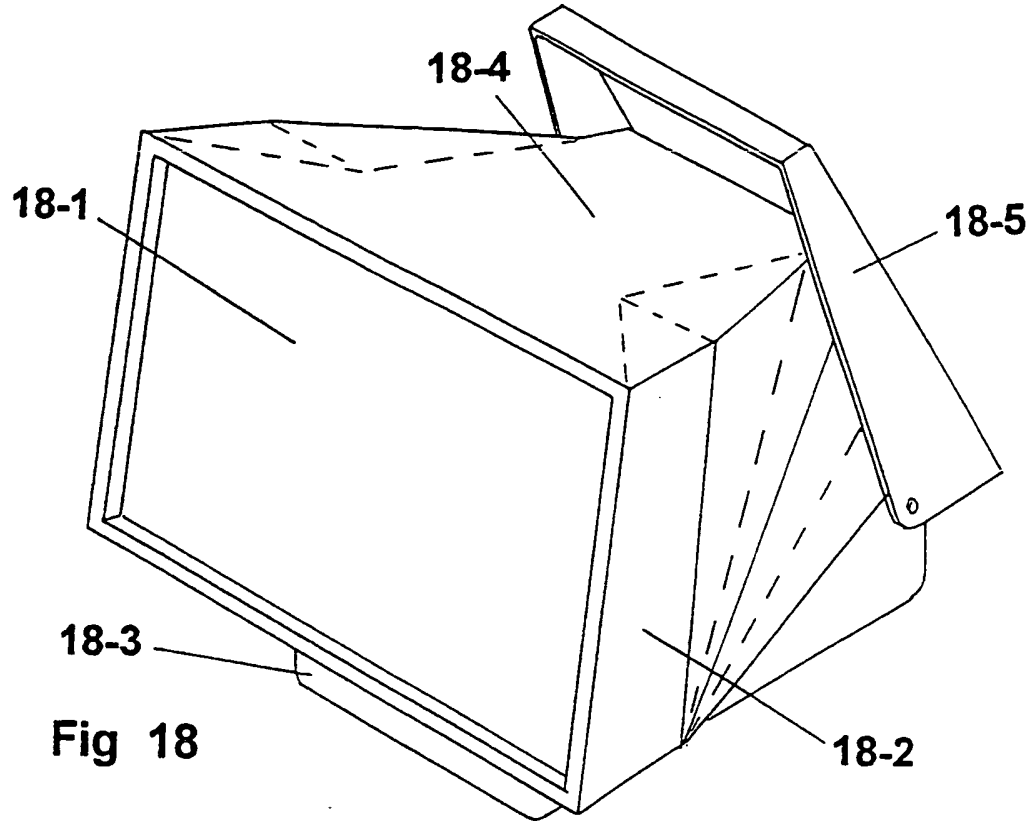
Fig 22

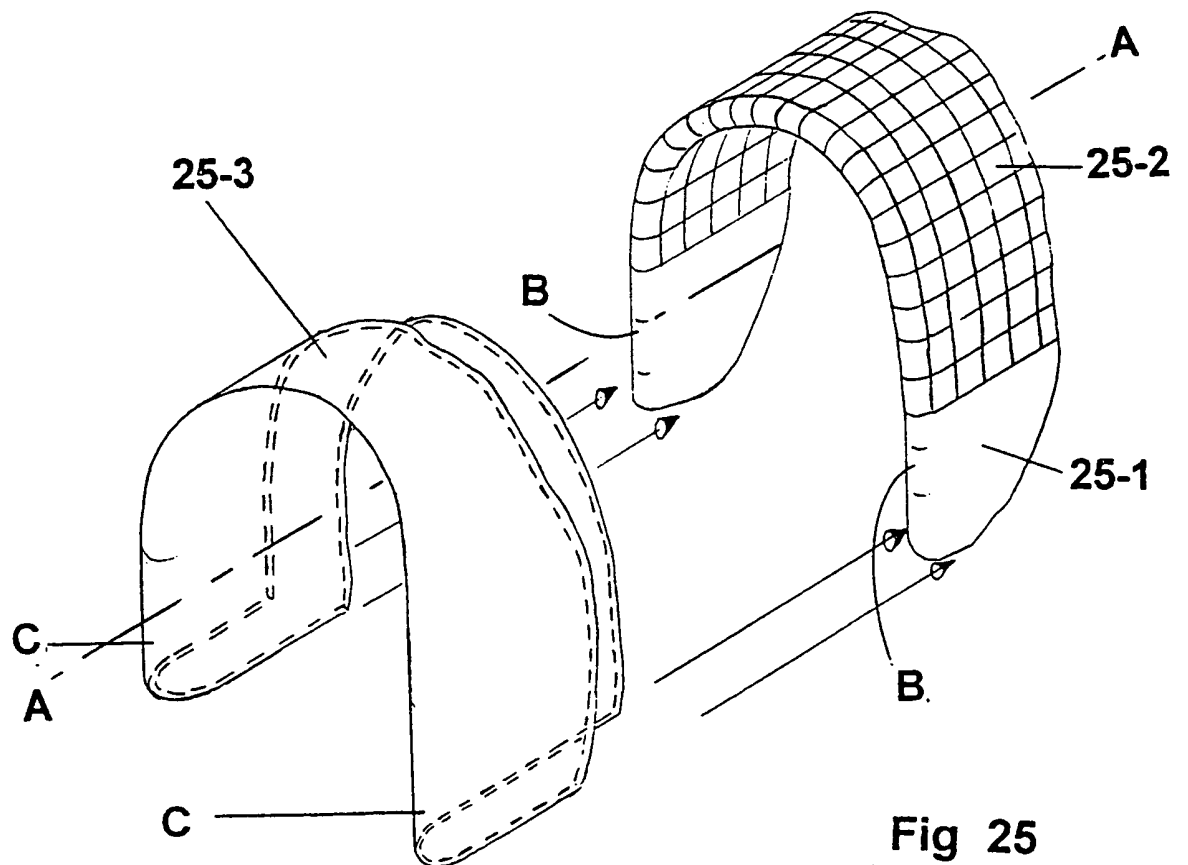
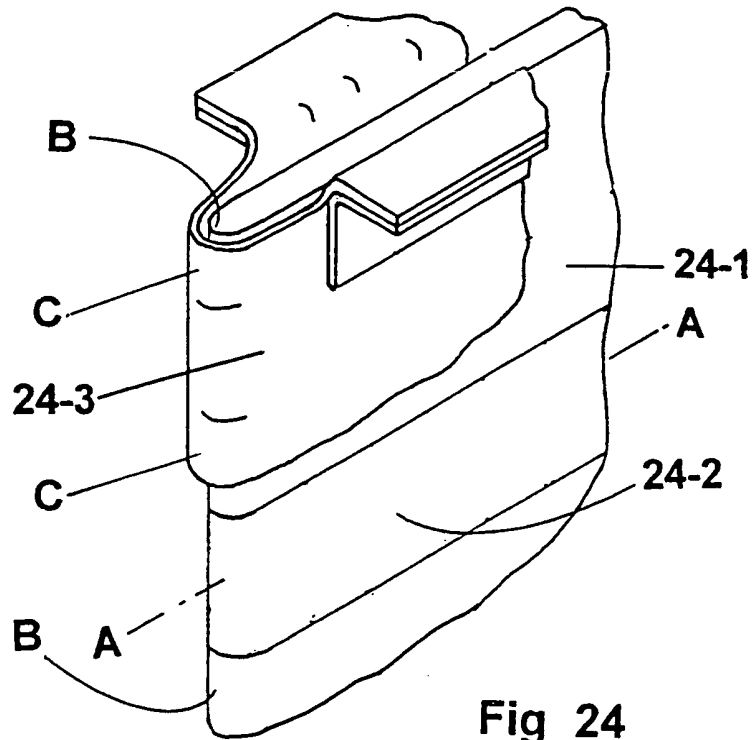


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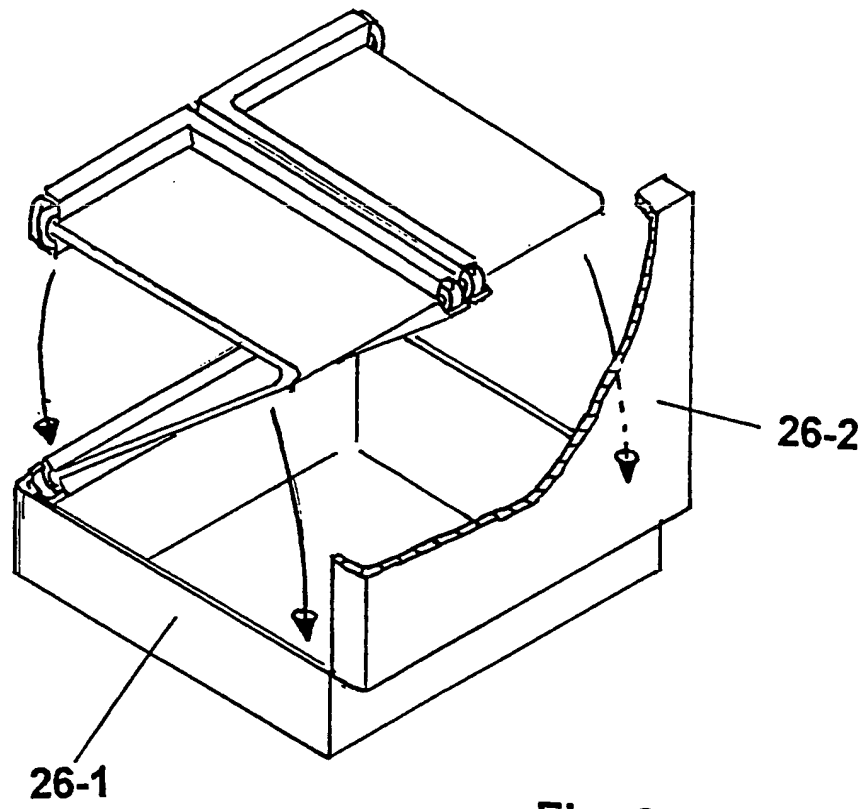


Fig 26

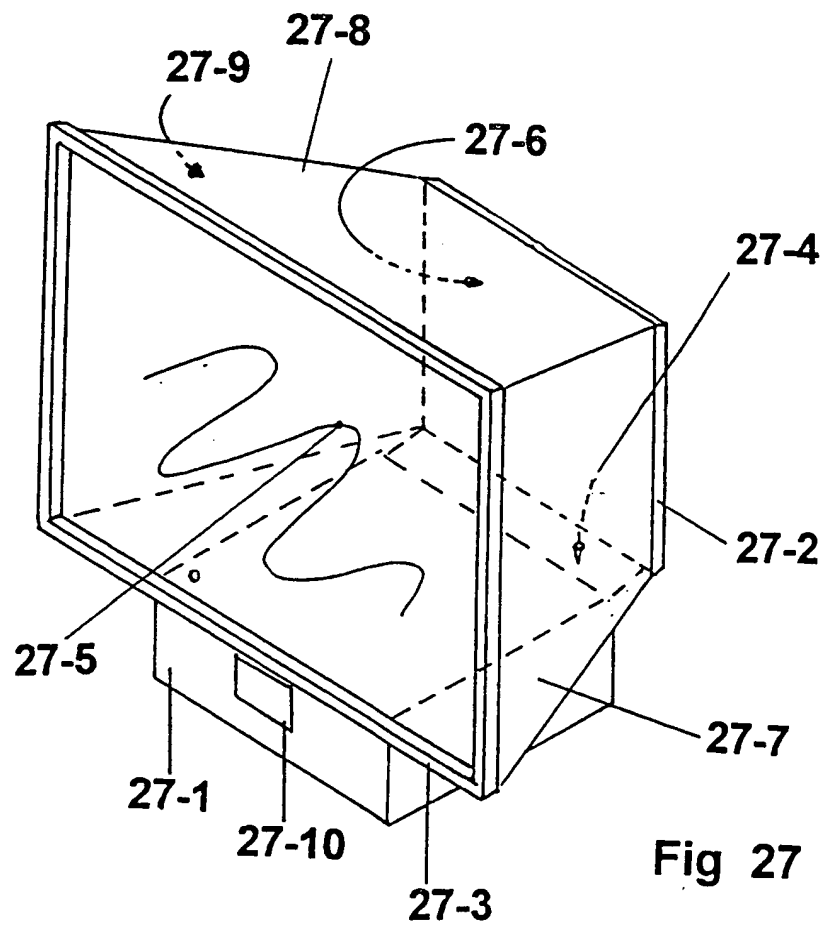
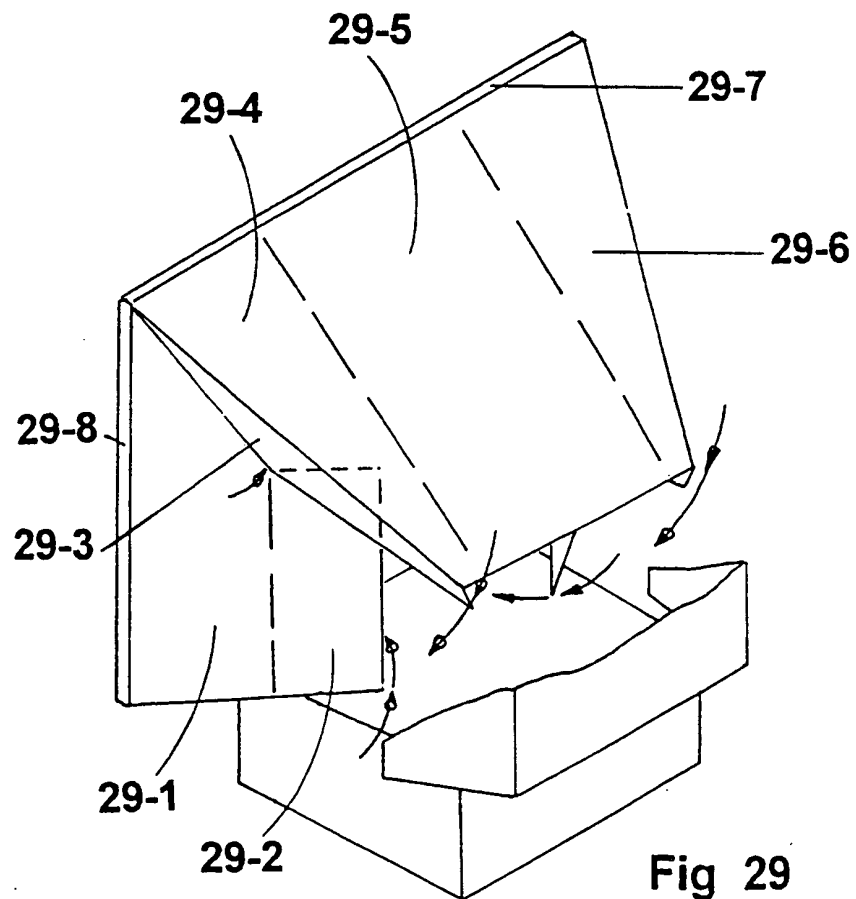
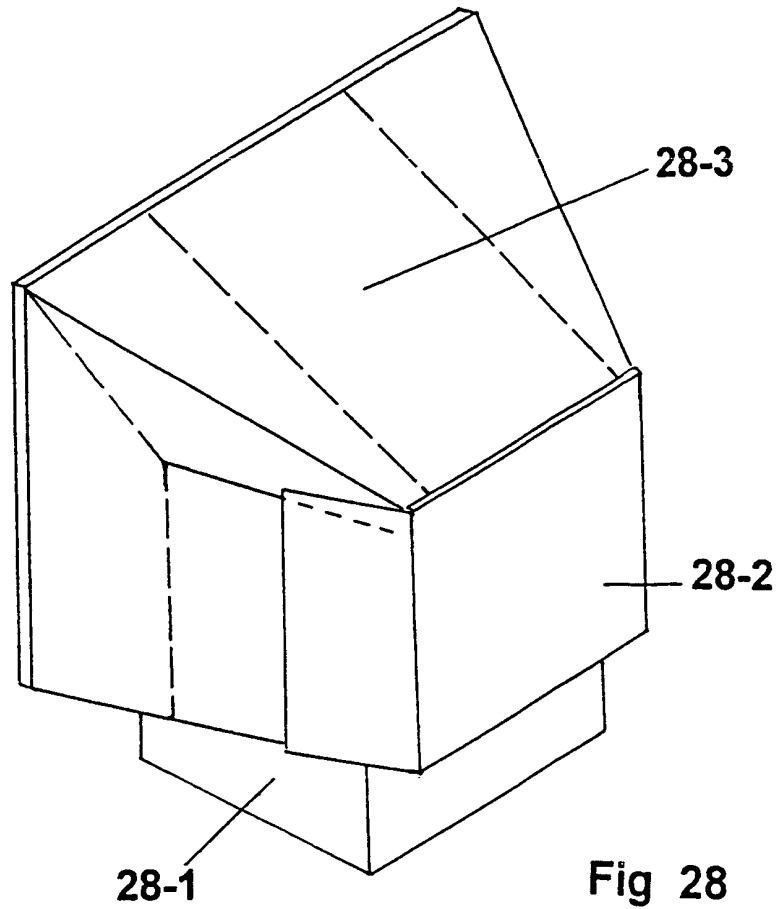


Fig 27



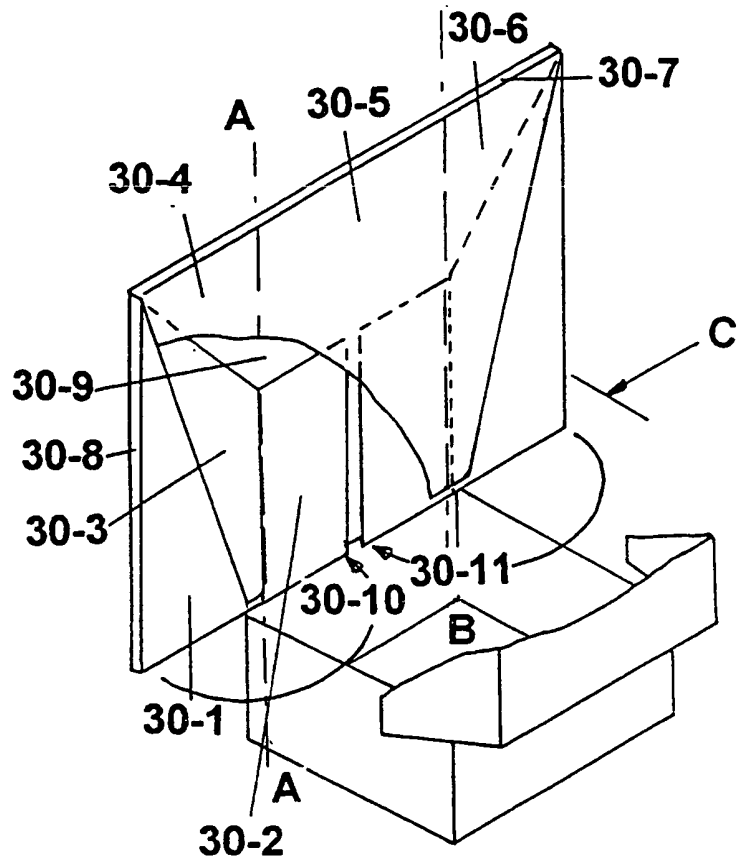


Fig 30

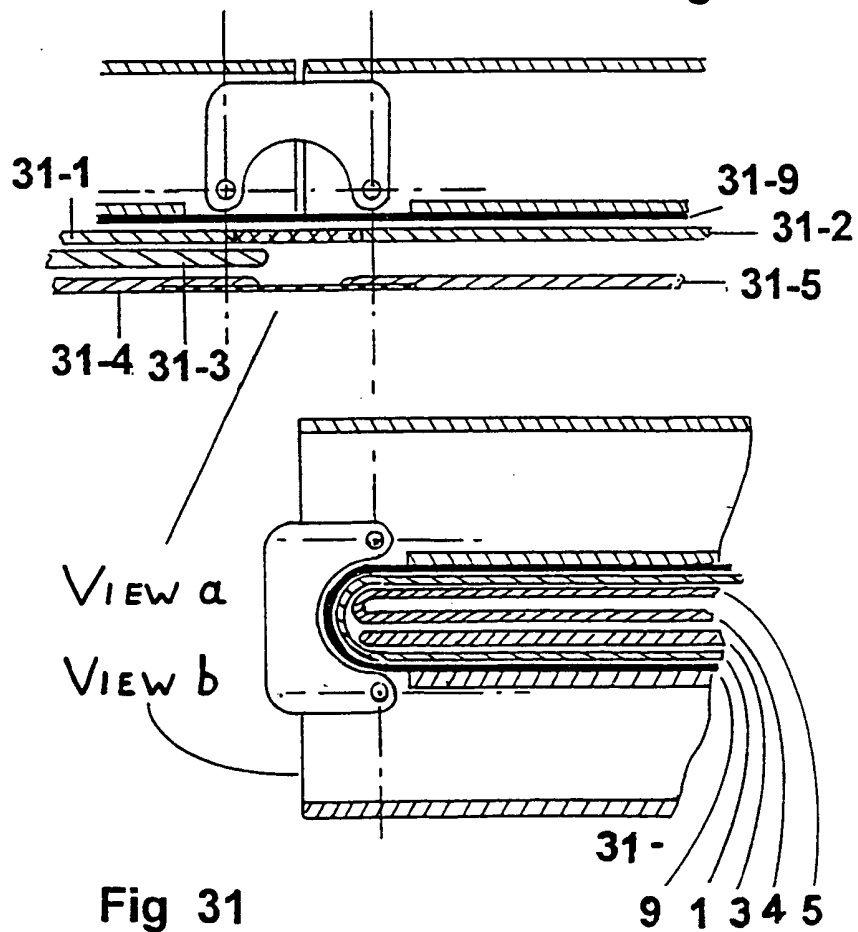


Fig 31

INTERNATIONAL SEARCH REPORT

International Application No
PC 1/GB 99/00734

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04N5/74

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N G03B G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 827 955 A (HURLEY A.) 25 March 1958 see the whole document ---	1-12, 15, 17, 20
X	PATENT ABSTRACTS OF JAPAN vol. 98, no. 1, 30 January 1998 & JP 09 230503 A (TOPPAN PRINTING CO LTD), 5 September 1997 see abstract ---	1-21
X	PATENT ABSTRACTS OF JAPAN vol. 98, no. 1, 30 January 1998 & JP 09 230504 A (TOPPAN PRINTING CO LTD), 5 September 1997 see abstract --- -/-	1-21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

*** Special categories of cited documents:**

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "G" document member of the same patent family

Date of the actual completion of the international search

28 June 1999

Date of mailing of the international search report

05/07/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Fax (+31-70) 340-3016

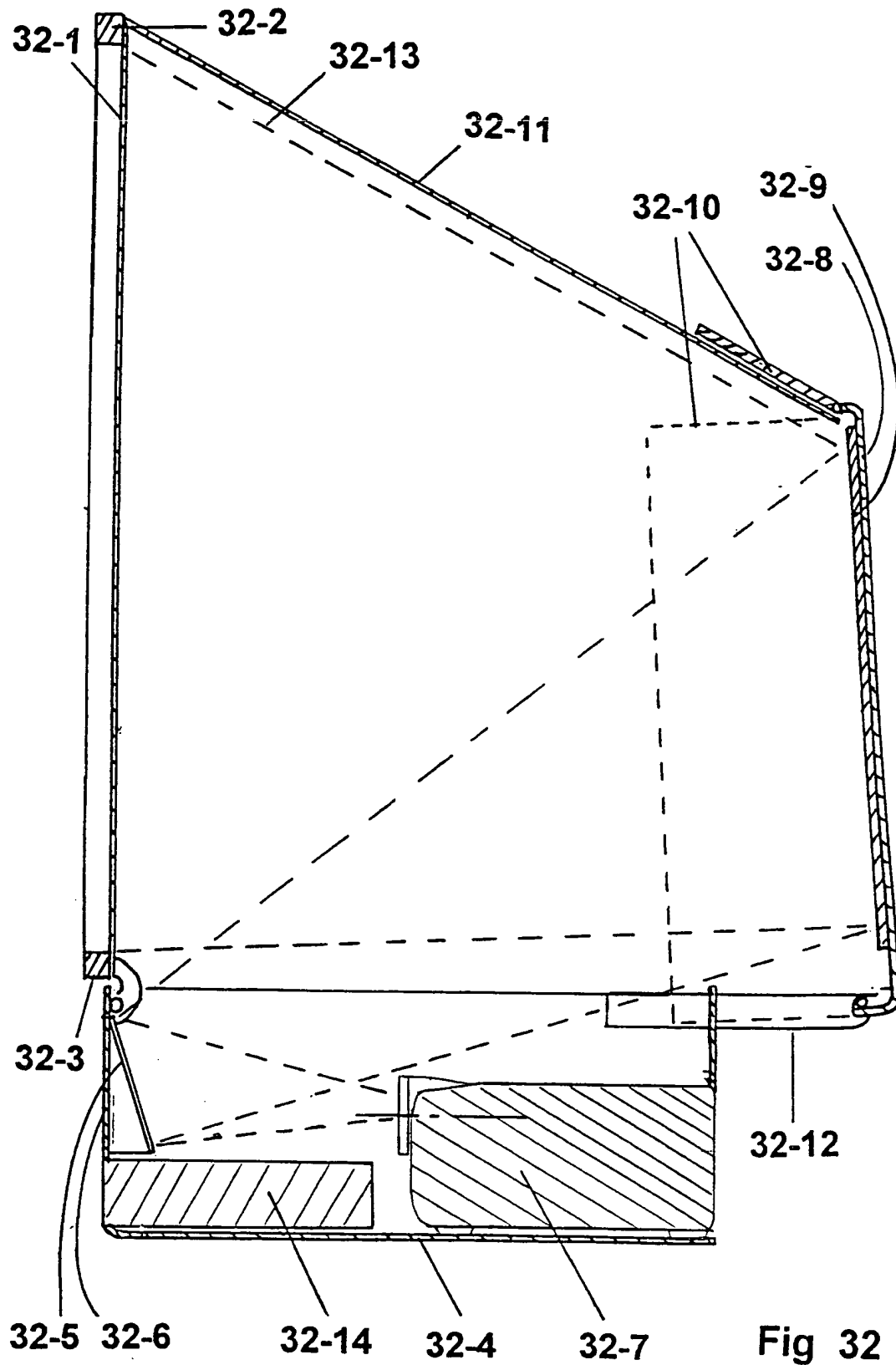
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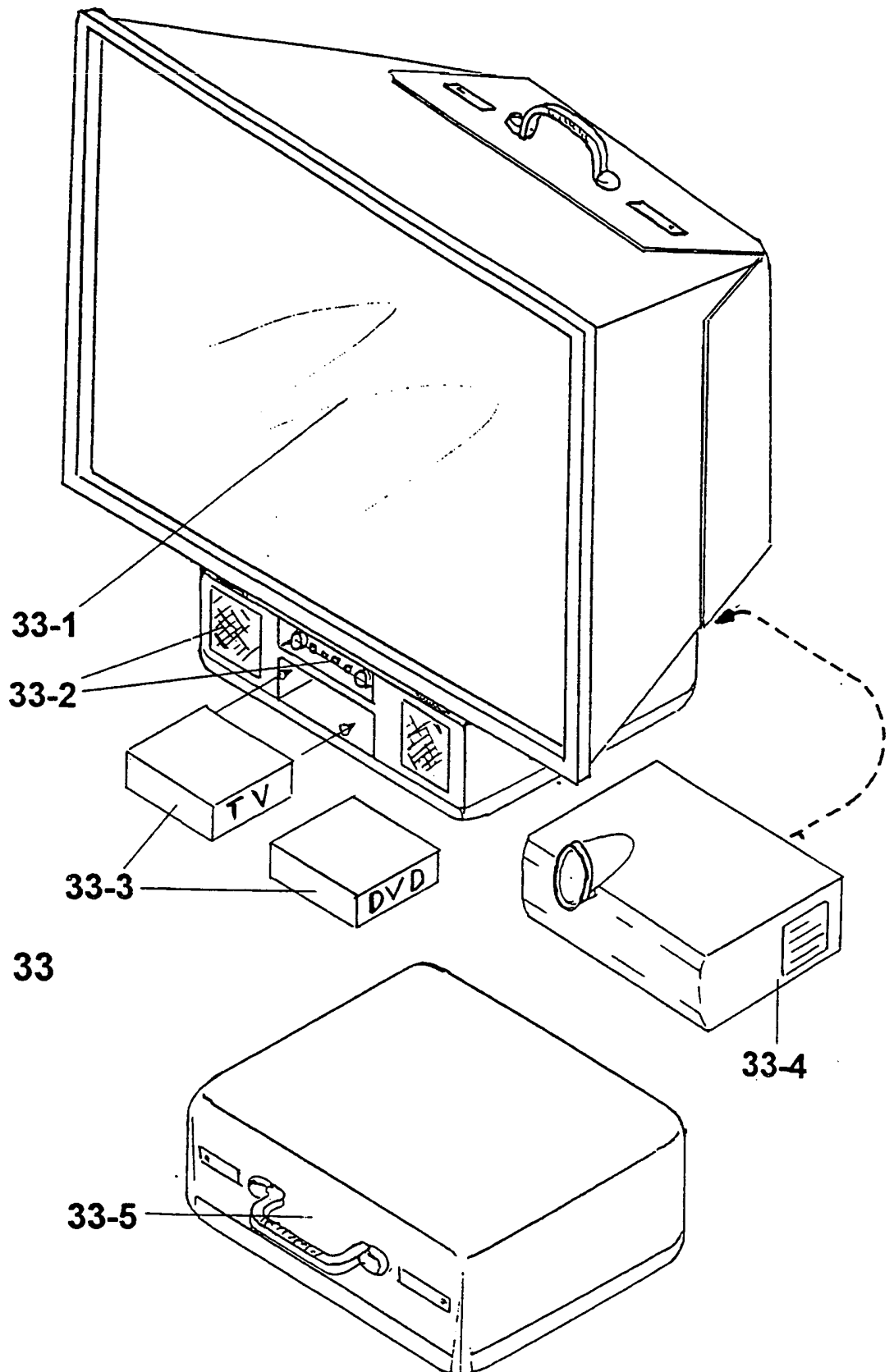
Verschelden, J

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00734

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 424 074 A (FAILLA S.) 24 April 1991 see column 11, line 21 - column 20, line 31 ---	1, 22, 23, 25-27, 29, 32-36, 40
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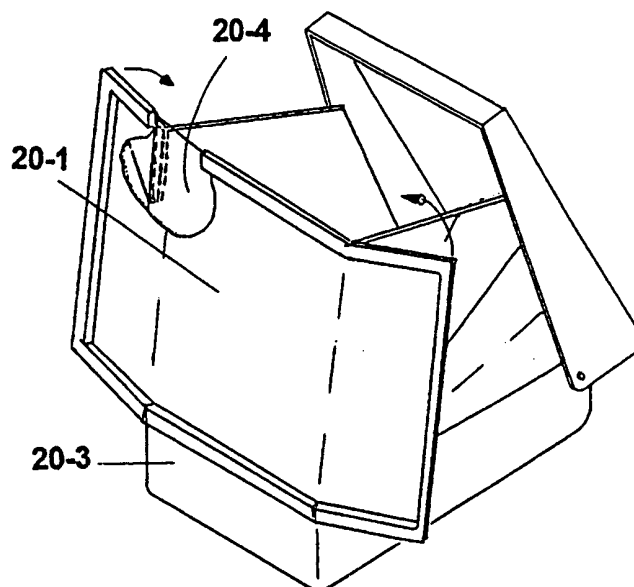




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(54) Title: PORTABLE VISUAL DISPLAY DEVICE WITH A COLLAPSIBLE PRESENTATION SCREEN



(57) Abstract

A collapsible presentation screen suitable for the presentation of still or moving images that are visible to a viewer situated in front of the front viewing surface by the diffusion of light images created within, or to the rear of the screen member. Embodiments are presented comprising a rigid or semi-rigid screen or alternatively a flexible and seamless screen and whereby the screen assembly when collapsed represents a much smaller size than its size when in the open condition thus rendering the screen readily portable and suitable as, or as part of a portable visual display device.

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